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EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
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Henry W. Hall, Manager.

CHARLES W. PRICE.....Editor-in-Chief
A. A. GRAY.....Managing Editor
MORTON GITHENS LLOYD.....Technical Editor
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PROBLEMS OF THE POWER SOLICITOR.

Standardization of the work of the electric power solicitor is a difficult problem for the central-station manager. In the field of illumination it is not a very serious matter in many cases to obtain valuable comparative data. Installations made in particular industries or in mercantile houses of a given kind present numerous similarities. The proper lighting of an engine lathe in a factory on the west side of a town is much the same as that of illuminating another machine of the identical type which may be located at the opposite point of the compass, and given the same type of wall coloring and approximately similar dimensions, experience gained in the illuminating of a modern shoe emporium on one street can be applied without danger of error to another in the next block. The quantity of illumination and the spacing and disposition of the lighting units may differ somewhat, but if the initial work is well done, the first establishment's equipment layout ought to be a good guide to that of the second.

In the power field things are quite different. Few central-station companies maintain sufficient information concerning their power loads, and frequently the cost of making a careful test of the actual power consumption of a given establishment looks fearsome. Personal judgment assumes too large a place in the selection of motors. The would-be power user is not seldom led into difficulties through the competing advice of manufacturers whose chief interest is in the sale of motors and auxiliary electrical apparatus. Again, it is hard to point out established plants which may be fairly compared with the proposed new installation. The work of the power solicitor does not show itself to the popular eye, and although his triumphs over the isolated plant and the old-line forms of motive power bring dollars to the station at times when otherwise the boilers, engines, dynamos and lines would be poorly occupied or even partially idle, the great differences between individual installations often make it harder to secure new business than in fields where comparisons of results obtained are more readily accomplished.

There appear to be just two general lines which may profitably be followed in trying to overcome these disadvantages of a hidden service, and those are the preparation of more complete information for the company files concerning the technical features of motor installations, and the

more thorough accounting of the benefits of the power load upon the system as a whole. Under complete information the company should include such matters as the horsepower, speed, type and voltage of every motor in its service; the size of the motor driving-pulley, gearing, shaft, or belting; the distance between driving-centers and speed variations permitted in cases where a constant number of turns per minute are not needed; the make, capacity, speed and any other exceptional points concerning the machine or group of machines driven by the motor, and, where possible, the amount of power required to operate the machinery under stated conditions as determined by tests made under responsible hands. Beyond this, the collection of blue prints or photographs of representative cases of motor driving on the central-station system are of great value in soliciting new business, and especially are these useful where the company is trying with might and main to dislodge some older and less efficient form of power from the field in the face of the natural opposition of the owner and of the operating force in his employ. Too few companies follow the above line of attack on the power prospect, and even where the local policy favors the making of the tests which are necessary to show to the owner and the central-station man precisely what is needed in the way of motor installation, companies often fail entirely to take advantage of the situation and preserve in their files of material the important points which in the future are certain to be so helpful to the department charged with the solicitation of additional motor patronage.

It is no new thing to emphasize these points, but certainly some such statement of their importance is justified by the failure of so many otherwise progressive plants to keep adequate statistics of their connected motor loads. It costs so little to maintain a card index carrying these details of power service and always keeping the management up-to-date concerning the motor load, that there is really not very much excuse for not doing so. And if a company once gets into the spirit of genuine power engineering, it is apt to accomplish marvels. No solicitor can be expected to carry in his memory the important details of motor service installed months since, and it is doubtful if any company can call itself well managed if the absence, illness or death of any single responsible employee in the power department can cripple the company's store of information concerning what it has actually done in placing motors in service. And finally, it would be well if the effect of the power business on the operation of the generating and distributing system were more generally looked into. Let the manager have some trustworthy subordinate plot each day the variations in the power demand upon the station in relation to the passing hours. Let him compare the effect of a growing power business upon the total demand of the consuming community upon the station, and the results will more than justify the trouble.

SELLING ELECTRICITY TO NATIONAL CONSUMERS.

The development of large business organizations having branch establishments in many parts of the country has lately brought the central-station man in contact with some difficult problems related to the sale of current for lighting and power service. Many of these national enterprises are thoroughly awakened to the possibilities of electrical advertising, the benefits of the motor drive and the economies of up-to-date illumination. Their travelling representatives, however, not seldom manifest pretty fixed notions as to what they desire in the way of service and rates, and it often occurs that the local central-station man is required to face arguments based on the practice of other cities and to justify his own charges and methods of supplying consumers before he can secure a contract to serve a house of such character.

It is hard for the layman to appreciate that the business of manufacturing and selling electric current is altogether different from that of distributing sugar or shoes to the general public. To the average man there is no apparent reason why the cost of putting a kilowatt-hour into a store in Georgia should be materially different from the expense of delivering that amount of electrical energy to a merchant in southern Illinois. The representative of a national house usually possesses a good deal of comparative data gathered from his experience in different cities, but he is rarely the owner of sufficient technical training to appreciate why prices for electricity may justly be different in divers communities. Not many months ago this matter reached an acute stage in a prominent manufacturing town of the East. The agent for the national organization argued that a store containing the same number of square feet, the same motor-driven coffee mills and fans, and the same brands of goods, operating the same number of hours each week and served by the same number of employees as another store a hundred or so miles away should be obliged to meet the same bill for electricity as its neighboring establishment owned by the same interests.

Among the reasons why rates for substantially the same service may fairly be different in two communities the following are worth noting: In one town the company may secure a portion, greater or less, of its total yearly production from a water-power station, its neighbor depending upon coal alone. Even where coal is used in both places the price per ton may differ from ten to forty per cent, on account of the local railroad tariffs. Again, one station may be of an entirely different design, requiring more men in its operation on account of the inconvenient arrangement of its steam and electrical generating machinery; the other may be located on costly ground in the heart of the business district, while the other sends current into town over a high-voltage transmission line, the distance from the plant to the center of distribution being anything from a few miles up to several score.

Further, one town may contain numerous factories using electricity for both lighting and power; the station load curve may exhibit a better demand upon the machinery in the day time, or through the night. The street lighting in one place may be cut off at midnight and in another run all through the hours of darkness. The extent to which electricity is used in residences and mercantile establishments will usually vary greatly, and the relative population of the two towns may in itself be enough to justify large differences in rates charged for practically the same service. There is no reason why central-station prices for current should be the same in different places any more than that a passenger should be able to ride ten miles for five cents in one town because in another he can ride double that distance for the same fare. Away down at the bottom of the matter is the fact that the cost of rendering service is seldom the same in communities which outwardly seem to be comparable. An experienced electrical engineer can quickly determine the natural and proper differences in conditions which account in a large measure for apparent discriminations in rates. Hence it is a good plan to collect statistics of different systems, noting the important differences in each case and preparing so far as possible to defend one's own rates upon the strength of the local conditions as contrasted with those prevailing elsewhere. A greater degree of co-operation between the officers of electrical systems of generation and distribution will do much to overcome the objections of national advertisers to paying different rates for similar services.

FACTORY LIGHTING.

The article by Mr. F. B. Allen, dealing with important considerations in factory lighting, found elsewhere in this issue, among other things calls attention, first, to the close relation between the efficiency of the lighting and the financial success of an industrial establishment; and second, to the advantages of the mercury-vapor lamp as a factory illuminant. The first point is now generally recognized. Unquestionably, the success of any plant depends upon the efficiency of the individuals employed, and it has been proven that an employee's efficiency depends, to no small extent, upon working in well-lighted quarters. The advantages of the mercury arc for factory lighting are also becoming more generally recognized. This type of lamp, together with flame and luminous arcs and tungsten units of 300 to 500 watts, are steadily coming into use and any one of these is far superior to the ordinary inclosed arc found in so many shops.

The general requirements for factory lighting besides sufficiency and continuity are uniformity, a general illumination, making the use of individual drop lights unnecessary except in special cases, the absence of glare, and a type of lamp adaptable to the conditions of the work over which the system is to be used.

The most approved method of securing these results is by means of the so-called overhead illumination system, in which the lamps are placed high enough to be out of the range of vision, and of a sufficient number to furnish illumination practically independent of the position of the work.

In view of these requirements, one of the hardest problems for the illuminating engineer to solve is that of factory lighting. This is due to the fact that a building for industrial purposes is primarily designed for use by day and the fact that it must occasionally be used at night or late in the afternoon is, perhaps, for economic reasons, lost sight of in the design. The result is that the most unfavorable conditions obtain for proper lighting. Girders, rafters, belts, cranes, irregular ceilings, etc., are the most common obstacles met with, and these are sometimes overshadowed by the improper design of the building itself. The one compensating feature is that the esthetic requirements are few, if any, and the illuminating engineer is therefore not limited in this respect.

The advent of the high-candlepower tungsten lamps, mercury-vapor lamps, flame and luminous arc lamps has done much to broaden the possibilities of factory lighting by furnishing units of sizes adapted to certain conditions which heretofore have not satisfactorily been met by either the arc or carbon-filament lamp.

THE ELECTRICAL EXPORTS FOR THE FISCAL YEAR.

A hopeful indication of the business outlook as regards the foreign electrical trade of this country is given in the statistics of the electrical exports for the past fiscal year, as published on another page of this issue. The classified data, as given month by month for the fiscal year ended June 30, 1911, show the usual fluctuations, although a marked improvement is noticeable in the last six months. A better general idea of the trend of the export trade is given by the annual totals, since in these the monthly fluctuations are fairly averaged. The annual summary shows that the past fiscal year has taken the banner, its total of $18,727,455 exceeding the previous record established in 1906-07 by $1,459,049. The world-wide depression that set in toward the close of 1907 has been completely overcome as regards the foreign trade in American electrical products. During the last fiscal year there was a gain of some four million dollars over the preceding twelvemonth. This alone is justifiable cause for gratification. An analysis of the figures into appliance and machinery exports shows again the predominance of the former over the heavier articles. This has been commented upon before in these columns. It shows that American telephonic equipment, which forms the bulk of the electrical appliance exports, is maintaining its undisputed lead in the telephone-supply markets of the world. The strong gain in electrical machinery exports is also auspicious as indicating a redevelopment of the demand abroad for American generators, motors, and their auxiliaries.

New Officers for Chicago Elevated Railways.

It is understood that Britton I. Budd, president of the Metropolitan Elevated, will be in charge of operation of the Chicago Elevated Railways. His title will probably be president, and it is expected he will be made president of the different underlying companies. President C. V. Weston, of the South Side Elevated, and Mason B. Starring, president of the Northwestern Elevated and of the Oak Park Elevated, will retire from those offices.

E. C. Noe, general superintendent of the Northwestern Elevated, will be next in authority under Mr. Budd. His title has not been, so far as can be learned, finally determined upon.

Mr. Budd has been president of the Metropolitan for several years following the retirement of H. G. Hetzler. Before becoming president Mr. Budd was general manager of the company. F. A. Delano, president of the Wabash Railroad and chairman of the board of directors of the Metropolitan, has been made one of the board of governors of the Chicago Elevated Railways. He is understood to think highly of Mr. Budd as an operating official.

Mr. Noe has been with the Northwestern Elevated for a number of years. He was formerly with the General Electric Company and is regarded as being well adapted for the position to which he will be appointed.

The choice of these two officials marks the beginning of the reorganization of the operating staffs of the several companies. Within the next two weeks further changes may be worked out. A great many more operating officers will necessarily not be needed under the new conditions.

C. V. Weston, president of the South Side Elevated, succeeded the late Leslie Carter as head of the company. He was formerly with the Yerkes lines as civil engineer and was a member of the Board of Supervising Engineers which directed the rehabilitation of the surface street railways.

Mason B. Starring, president of the Northwestern Elevated, has not announced his plans for the future. About a month ago he was made president of the Oak Park Elevated to succeed the late Clarence Knight.

As a part of the general street railway changes, it is understood that T. E. Mitten, president of the Chicago City Railway Company, will retire from that position. Mr. Mitten has taken no part in the merger plans of the "L" roads, nor in the proposed merger plans of the surface lines. He has recently become identified with Philadelphia traction interests and is expected to go to that city after retiring from the presidency of the Chicago City Railway.

Edwin E. Jackson, Jr., Fined $45,000 in Wire Case.

In line with the developments which have marked the progress of the Government's campaigns against the wire manufacturers indicted for forming pools in alleged violation of the anti-trust laws, Judge Archbald inflicted a fine of $45,000 upon Edwin E. Jackson, Jr., of New York, upon his plea of nolo contendere on August 4. United States District Attorney Henry A. Wise bitterly arraigned Jackson as the "head and brains of the trust."

Ten of the indicted men, including Mr. Jackson, changed their pleas of not guilty to nolo contendere. They were fined $1,000 each, with $100 more for each additional indictment. Against Mr. Jackson nine indictments were found and his fines were $5,000 for each count. In addition he was sentenced to pay $2,600 in costs. Others who pleaded and were fined on August 4 were Herbert L. Satterlee, William S. Kyle, Wallace D. Rumsey, George E. Holton, Frederick I. Hall, J. B. Olson, James H. Sieberling, Benjamin S. Wolf and Eugene R. Phillips.

Government Line to Life-Saving Station.

The United States Government intends to install a telephone line connecting the lighthouse and life-saving station at North Cove with South Bend, Wash. The City Council has passed an ordinance granting the Government permission to use the streets and alleys of the city for the purpose of bringing the line from the river to the station.

Interborough Plan Rejected.

At a recent meeting of the Board of Estimate of New York city the latest Interborough plan for subway construction was rejected. The plan called for a guarantee of nine per cent on its $125,000,000 investment.

After rejecting the Interborough plan, it was voted by the Board to give all lines to the Brooklyn Rapid Transit Company.

New Trolley Charters in Connecticut.

During its closing session the Connecticut General Assembly passed several trolley charters and extended the charter rights of a number of companies operating in that state. Among these is the additional right to the Short Line Electric Railway Company, the Plant Company, to lay additional tracks between its Saybrook-Essex line and the Old Saybrook ferry, and to sell electricity in Lyme, East Lyme, Chester, Saybrook, Essex, Old Saybrook, Clinton and Madison. This company will furnish the electricity for the working of the new State toll drawbridge which will take the place of the present Old Saybrook-Old Lyme ferry, on the main route.

The new trolley charters which have passed the House are those of the Norwalk and New Canaan Electric Railway Company and the New Britain, Kensington & Meriden Street Railway Company. The former is a renewal of a charter which was allowed to lapse several years ago and provides for a trolley line between the city of Norwalk and the village of New Canaan.

The House has also passed the extensions and additional charter rights of the Connecticut company in Hartford, New Haven, Orange, Meriden, Norwich and New London and of the Connecticut Railway & Lighting Company, now operated by the New Haven Road's trolley corporation, in Waterbury, Fairfield, Stratford and Bridgeport.

Citizens Remove Power-House Dam.

Citizens of Maywood, Ill., on August 8, destroyed a dam belonging to the North Shore Electric Company, on the Desplaines River, near the company's Maywood power house.

This action followed the demand of the citizens of Maywood and River Forest that the North Shore Electric Company remove the dam in a specified time, it being claimed that this dam was largely responsible for a plague of mosquitoes which has afflicted the two villages during the summer.

Electrical Investigation in Texas.

At the direction of the Texas Legislature an investigation of the telephone, telegraph and other electrical businesses is being carried on. The investigation is being made with the view of instituting prosecutions should sufficent evidence be found that the Texas trust laws are being violated.

Otto E. Osthoff.

Few engineers have advanced to such heights in so short a time as Otto E. Osthoff, vice-president and chief engineer of H. M. Byllesby & Company, Chicago. Mr. Osthoff was born in Cleveland, Ohio, October 4, 1874. At the age of six years his parents removed to the town of Delphos, Ohio, where he received a common and high-school education. At the age of sixteen he entered Adelbert College of Western Reserve University, Cleveland, Ohio, and pursued classical studies for a period of three years, and then went to the Case School of Applied Science, Cleveland, where he completed an advanced course in physics and mathematics, graduating in 1896 with the degree of B. S. In addition to the regular course, studies were incidently pursued in mechanical, electrical and hydraulic engineering.

When in school Mr. Osthoff was the recipient of numerous honors. He won the Reid prize in physics, given annually by Dr. Reid of John Hopkins University, to the student passing the best special examination in physics, and he also obtained the highest average grade in all studies in his sophomore year. Mr. Osthoff served as editor-in-chief of the *Differential*, the college annual, and was also instructor in physics for one year while following regular studies.

Mr. Osthoff graduated in 1896 and immediately entered the service of the Willard Storage Battery Company, of Cleveland. During his first year's connection with this company he pursued post-graduate studies and in 1897 received the degree of E. E. from the Case School. His thesis was on the subject of "The Design of Central Storage Batteries."

Until 1900 Mr. Osthoff remained with the Willard Company, assisting in the design of its storage battery plates, he then became associated with the Electric Storage Battery Company, of Philadelphia, Pa. While with this company Mr. Osthoff was in charge of several notable installations in New York and Brooklyn and in 1901 he was sent to Chicago as district engineer of the company.

In 1902 Mr. Osthoff became associated with H. M. Byllesby, of Chicago, and upon the organization of H. M. Byllesby & Company was made a vice-president, director and chief engineer of that company. He has been identified with H. M. Byllesby & Company ever since, having direct charge of the engineering department, which embraces all engineering pertaining to the electric, hydroelectric, gas, street-railway, waterworks and telephone properties controlled by the company.

OTTO E. OSTHOFF,
Vice-President and Chief Engineer, H. M. Byllesby & Company.

In addition to this he is vice-president and director of the Interstate Light & Power Company, of Galena, Ill.; Western States Gas & Electric Company, Appalachian Power Company, vice-president and director of the Northern Idaho & Montana Power Company, director of the Takoma Gas Company, director of the Fort Smith Light & Traction Company, director of the Bitter Root Mountain Water Company and an official and director of the Chicago Securities Company.

Since becoming associated with the Byllesby organization, Mr. Osthoff has been identified with many notable engineering projects. He has acted in the capacity of consulting engineer for the City of Duluth, having had general charge of the recent large extensions there of the water works and municipal gas plant, and he designed and constructed the new artificial gas works for the United States Steel Corporation at Gary, Ind. He has also had general supervision of the design and construction of the hydroelectric plants built at Sioux Falls, S. D.; Mankato and Cannon Falls, Minn.; Somerset, Wis.; Big Fork, Mont., and several others still under construction. He has also had general charge of the design and construction of the new steam plants at San Diego, Cal.; Oklahoma City and Muskogee, Okla.; Mobile, Ala.; Fort Smith, Ark.; Ottumwa, Ia., and some half dozen steam plants recently constructed for the Northern States Power Company, operating in Minnesota, including the city of St. Paul, and for the Northern Idaho & Montana Power Company in the states of Idaho, Montana, Oregon and Washington. The crude-oil gas works at San Diego, the water and coal-gas plants at Oklahoma City, Muskogee and Enid, five coal and water-gas plants controlled by the Northern States Power Company and the new gas works at Tacoma, Wash., Springfield, Ore., and Oshkosh, Wis., were also designed by Mr. Osthoff.

Active in society and club affairs, Mr. Osthoff holds membership in the American Institute of Electrical Engineers, Western Society of Engineers, American Water Works Association, American Gas Institute, National District Heating Association, American Academy of Political and Social Science, American Civic Alliance and American Association for the Advancement of Science. He is also a member of the Union League Club and the University Club of Chicago, Lawyers' Club of New York, Arlington Club of Portland, Ore., and the honorary Greek letter fraternity Sigma X.

Electrical Exports for June and for the Fiscal Year 1910-11.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its monthly summary of the imports and exports of the United States for the month of June and, therefore, also the annual summary for the fiscal year ended June 30, 1911. From these statistics the following data relative to the exports of electrical products are obtained.

The figures for June are quite satisfactory for the falling off in appliance exports from the last few months is more than made up by the gain in machinery exports, the total being practically equivalent to that of May, 1910, which was the record month until April 1911, surpassed it. The monthly fluctuations during the past fiscal year are shown by the following data, the figures for June of last year being also included for comparison:

Month.	Electrical Appliances.	Electrical Machinery.	Total.
June, 1910	$ 902,593	$586,202	$1,488,795
July, 1910	839,059	745,419	1,584,478
Aug., 1910	852,958	708,160	1,561,118
Sept., 1910	762,152	578,246	1,340,398
Oct., 1910	780,233	514,184	1,294,417
Nov., 1910	884,326	612,007	1,496,333
Dec., 1910	826,183	646,639	1,472,822
Jan., 1911	965,936	687,536	1,653,472
Feb., 1911	939,714	551,885	1,491,599
Mar., 1911	915,001	639,338	1,554,339
Apr., 1911	1,064,562	888,283	1,952,845
May, 1911	987,264	627,840	1,615,104
June, 1911	884,839	825,091	1,709,930

The following table gives the comparative figures for the last five fiscal years, each including the twelve months ending June 30, and shows clearly the general tendencies in the electrical export trade and the striking fact that the past fiscal year has broken the records in its total shipments of electrical products:

Year.	Electrical Appliances.	Electrical Machinery.	Total.
1906-07	$ 8,262,640	$9,005,766	$17,268,406
1907-08	6,754,217	8,495,219	15,249,436
1908-09	6,074,865	6,449,526	12,524,391
1909-10	8,694,132	6,048,263	14,742,395
1910-11	10,702,827	8,024,628	18,727,455

Reverting back to the figures for last June, the principal countries to which electrical shipments were made and the values of the exports are given below:

Countries.	Electrical Appliances.	Electrical Machinery.
United Kingdom	$ 64,016	$103,513
Canada	313,029	145,485
Mexico	67,048	145,032
Cuba	47,708	10,007
Brazil	193,371	101,146
Japan	38,050	99,037

The Pay of German Telephone Operators.

Telephone "girls" in Germany cannot work after the age of seventy, though they can retire on pension prior to that advanced age. Positions are obtained by civil service examination. The average age on entering the business is said to be in the neighborhood of thirty years, and many remain for life. Discharges cannot be effected without considerable red tape. When an operator has worked up to $450 a year and $150 extra for house rent, she stays at that pay until pensioned.

The Copper Situation.

Considering the forthcoming Copper Producers' statement, information comes from a reliable source that there will be a decrease of about 13,000,000 pounds, which will be the largest for any one month since September, 1910. The exports undoubtedly will be the largest for any month thus far reported this year.

The reports from the largest producers would seem to indicate that they have no great amount of copper for sale that is due for delivery from refineries. By this is meant that practically all of the 250 odd million pounds of copper at smelters, in transit to the refineries, and at the refineries, blister copper and material in process of refining, has been sold ahead.

The big electrical companies report a number of large orders as placed recently, but they are beginning to worry somewhat about the business that may be placed this fall. Foreign consumption of the metal is all that can be expected and there was a shrinkage in the foreign visible suply for the month of July of 3,342,080 pounds.

Taking everything into consideration, the technical position of the metal seems to be strong, but an increased demand for copper in this country will be necessary to keep stocks from increasing the next two or three months.

Cross of Electric Lights on Church Steeple.

A cross outlined in electric lamps on the steeple of St. Mel's Catholic Church, at Forty-third Avenue and Washington Boulevard, Chicago, is somewhat of an innovation. The cross is nine feet high and six feet wide. Each side of it is outlined by thirty four-candlepower carbon lamps. This cross can be seen very distinctly at night for a distance of twenty-five city blocks in a direction at right angles to the arms of the cross. Rev. Father McDonald, who is in charge of the church, expresses himself as well pleased with the results obtained by the use of electricity for lighting this church emblem.

Seasoning Wood by Electricity.

A consular report from Birmingham, England, gives the following particulars of a new process for seasoning wood, said to be worked in France: A large tank is filled with a solution containing ten per cent of borax and five per cent of resin, with just a trace of carbonate of soda. In the bottom of the tank is a lead plate which is electrically connected to the positive pole of the dynamo. The timber to be treated is stacked on this plate, and when the tank has been filled another plate is superimposed and connected to the negative pole of the dynamo.

When the current is switched on it passes through the stack of wood between the two plates, and in its passage it is said to drive out the sap in the timber and deposit borax and resin in its place, completely filling up all pores and interstices. When the process is completed the timber is removed and dried, after which it is ready for use. It is claimed that the timber submitted to this treatment, no matter how green it may be, becomes completely seasoned.

Arc-Light Equipment for Chicago.

The Sanitary District of Chicago has definitely decided to install immediately for street lighting 500 flaming-arc lamps of the long-burning type. Of these, 250 will be of a type used in street lighting in Europe and supplied by the Stave Electrical Company, and 250 of an American type, developed by the General Electric Company. After sixty days of operation, the rest of an equipment of 4,000 lamps will be awarded to the concern whose lamps give most satisfaction, and eventually 15,000 lamps of the kind selected will be installed. Both lamps are of the ten-ampere type and are to operate 100 in series with fifty-five volts at the arc. As this is the first municipal installation in this country of flaming arcs on a large scale, a successful outcome of the Chicago test will have a wide influence on future street lighting.

Twin Arc Posts for Philadelphia.

According to recent newspaper dispatches Mayor Reyburn will send a message to the Council again urging action on a bill providing for the erection of twin arc lights like those in the center of the city on principal business thoroughfares and squares in various parts of the city.

Electrification of a Rand Gold Property.—II.

The Power Plant of the Randfontein Group of Mines.

GENERATORS.

The generators are built to deliver three-phase current at a frequency of fifty cycles and at a pressure of 6,600 volts between phases. This pressure is high enough to suit the radius of supply and load, and low enough to connect direct to the line without transformation. All generators are of the revolving-field type, the 6,000 sets having cylindrical type with distributed windings and the other units having salient poles. The salient-pole magnets are wound with copper tape on edge, and in the latter design the magnet coils, before being slipped over the poles, are inclosed in tinned-steel cases, the connection being brought out through closely fitting tubes soldered to the case, thus hermetically sealing the coil. The object of the casing is to avoid crushing and displacing the insulation on the coil, a matter that not infrequently happens when the enormous pressure due to centrifugal force is exerted on the coil when the rotor is at full speed.

The generators are designed to give their full output at a power-factor of 0.7, the regulation at unity power-factor being 18-20 per cent.

The overload guarantees are fifty per cent for half an hour and twenty-five per cent for two hours, and this without the use of the by-pass.

The temperature rise guarantee for all generators, with the exception of the two 1,000-kilowatt sets, are: Iron fifty-five degrees Fahrenheit; stator coils, forty degrees Fahrenheit; and rotor, forty-five degrees Fahrenheit. These guarantees are with natural ventilation in the case of the salient pole machines, but fan blades are attached to the rotors of the cylindrical-type magnets.

Ventilation becomes a problem owing to the small bulk and external surface of a high-speed machine as compared to the slower-speed generators for the same energy loss. This is provided for in the Parsons machine by ample spacing pieces in the stator laminations, allowing air to be drawn in through the stator foundations by the fan-like action of the rotor, and discharged through the top of the stator.

ELECTRIC HOISTING MACHINES AT RANDFONTEIN MINES.

In the cylindrical type of rotor, in which the fan action is very little, the ventilation is assisted by fan blades mounted on a spider keyed to the shaft-end of the rotor.

The limit to output is generally found to be not at the turbine end, but, in maintaining voltage, at the generator terminals with ordinary motor loads of low power-factor, due to saturation of the field magnets. In testing generators for overload capacity at this station, this has in every case determined the limit, and it presents a dangerous feature, due to the fact

that an unobservant switchboard attendant may, on heavy loads, in endeavoring to maintain voltage, especially if steam pressure is a little low, continue passing current into the rotor windings after the saturation point is reached and damage the rotor insulation.

A steam consumption test of a 6,000-kilowatt set was lately carried out, and the results are appended. As can be seen, the test was carried out on an ordinary working load.

The machine at the time was not working in parallel with other machines, and the load it carried was as much as could be conveniently segregated, and sufficient at all events to give the desired information.

6,000-KILOWATT TURBINE STEAM-CONSUMPTION TEST.

Capacity of turbo-generator	6,000 K. W.
Duration of test	6 hours
Average steam pressure at stop valve	148.5 lbs. pr sq in.
Average steam temperature at stop valve	475° Fahr.
Mean speed	1,000 R. P. M.
Average K. W. load	5,008 K. W.
Average power factor	77%
Mamimum K. W. load	5,803 K. W.
Minimum K. W. load	4,110 K. W.
Total water used	468,549 lbs.
Water used per hour	76,425 lbs.
Average water rate per K. W. hour	15.25 lbs.
Vacuum (average)	22.55" Hg.
Barometer	24.9" Hg.
Average discharge temperature	94.734 Fahr.
Average inlet temperature	81.369° Fahr.
Average generator temperature (core)	118.7° Fahr.
Temperature of generator (house)	85.9° Fahr.
Average excitation	27.02 K. W.

SWITCHING APPARATUS.

The whole of the high-tension switching apparatus is remotely controlled and mechanically operated, with the exception of the switches for the 6,000-kilowatt generators, which, owing to their size, are actuated electrically by solenoids.

No high-tension current is brought to the operating platform, the instruments being actuated from series and potential transformers in the chambers, the secondaries of which are grounded to a common grounding bar connected at several points to the condensing plant.

Owing to the disposition and concentration of the loads to be provided for, the busbar arrangements are very simple, consisting of two sets of busbars superimposed and running the whole length of the high-tension structure.

Transfer isolating switches allow any generator or feeder to be connected to either set of bars, and a busbar-paralleling switch with synchronising gear effects any desired transfer of load. No further sectioning of the busbars has been found necessary, the normal conditions of running being that all generators and feeders operate in parallel, leaving a spare set for testing or emergency purposes.

Connections from the generators to the high-tension compartments are made by cable similar to the main feeders, but with a higher safety factor, these cables being constructed for 160,000 volts pressure. The connecting cables run through two parallel tunnels 7 feet 3 inches high by 3 feet 7 inches wide, running the length of the generator house and connected by cross tunnels. One tunnel runs adjacent to the foundations of the generators and the other immediately under the high-tension chamber.

The generator circuits were originally protected by reverse-current relays, now disused. Until a balancing system, which is under consideration, has been installed, a partial protection by overhead relays is provided and set up sufficiently high to act in the remote but possible contingency of a short-circuit in any high-tension apparatus.

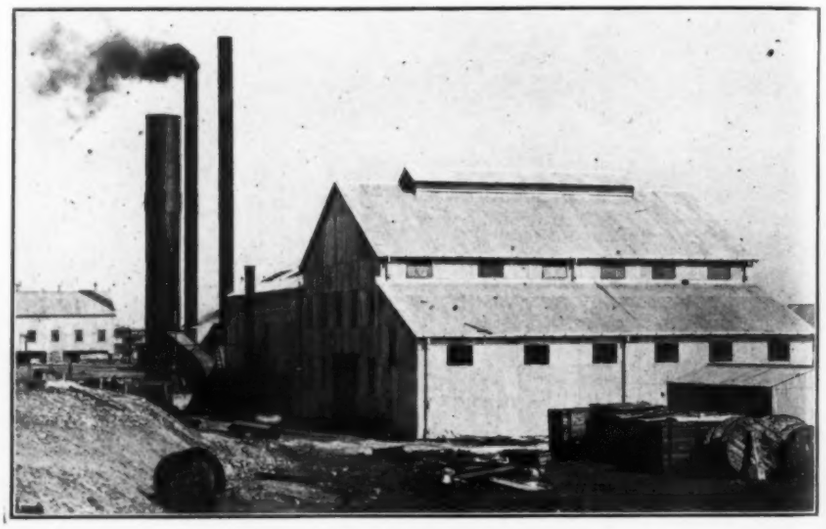
All feeders are protected by overload relays with inverse time action, the retardation being effected by dashpots. The trip circuits, as well as all emergency lights, signals, etc., and the solenoids of the electrically operated switches, are actuated by direct current from a battery of accumulators.

The generator windings are connected in star, but not grounded, although in view of the fact that experience may prove grounding to be necessary on this system, alll three phases have been provided with series transformers and meters.

Paralleling is carried out by two synchroscopes in parallel. The first, being an instrument of large diameter with illuminated dial, indicates the speed, and is visible to the operator from any point in the generator house, the latter instrument, being much smaller and more sensitive, is relied on when closing the circuit.

Spark gaps of the Westinghouse type, with series and shunted resistances, are connected to each set of busbars to take care of any rises of potential; also these are connected to every substation busbar as mentioned later.

The station auxiliaries are supplied from three 500-kilowatt transformers, located in a substation at the eastern end of the generator house. Here the pressure is reduced from 6,600 to 550 volts, at which pressure all station motors are operated. Lighting is provided for by further transformation to 120 volts. The auxiliaries, including artesian-well pumps, are in every case driven by induction motors with the exception of the cranes, and represent an installed plant capacity of 1,400 horsepower.



EXTERIOR OF GENERATING STATION.

TRANSMISSION SYSTEM AND SUBSTATIONS.

The high-tension transmission system consists of seventeen 6,600-volt feeders comprising approximately thirty-two miles of cable, all operating in parallel.

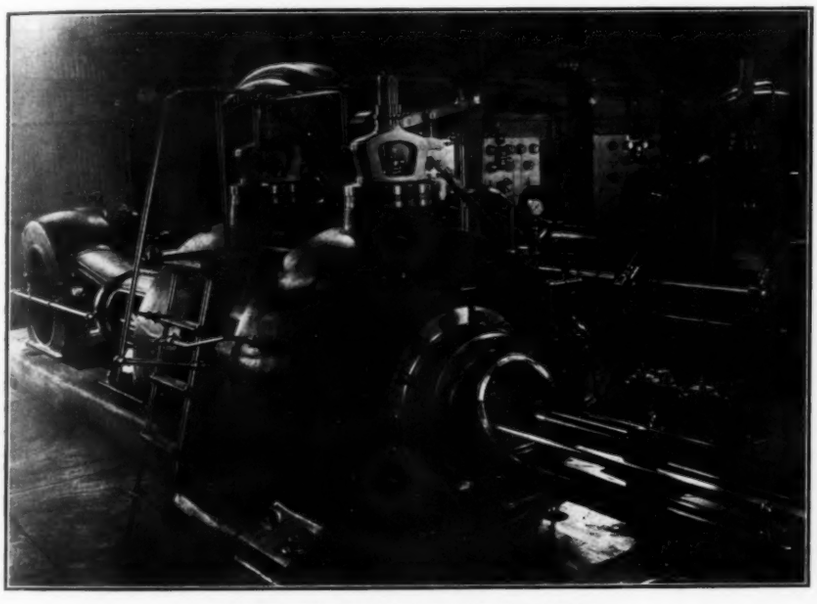
The substations are in two standard capacities, viz., 6,000-kilowatt and 3,000-kilowatt, and all provided with static equipment. The transformer units adapted are 500-kilowatt single-phases having two ratios, 6,600 to

2,200 and 6,600 to 550. Line drop is compensated for by taps on the primary.

The choice of single-phase units was decided on by the writer owing to flexibility and ease of transport. Connections on both high and low-tension sides are in mesh and allow two transformers to carry on a temporary supply of eighty per cent of the capacity of the balance in case of failure of one.

The operating panels in the substations are on a level with the high-tension structure, but with this exception, all apparatus and arrangements are identical with that at the power station.

Distribution from all substations is made by underground cable at either 2,000 or 500 volts, so that the transformers are protected on both sides.



LARGE UNIT IN RANDFONTEIN PLANT.

CAPITAL COSTS.

The actual costs of the power station and system are not yet available. The work is completed, however, and the costs are approximately known. They are about three per cent higher than the estimates, in which no contingencies were allowed.

The estimated cost was $1,515,000 divided up as follows:

Boiler plant	$ 605,000
Cooling tower, piping and launders	65,000
Generator and condensing plant	485,000
Substations	120,000
Transmission cables	105,000
Buildings	55,000
Workshops, artesian wells and later additions	80,000
	$1,515,000

Taking the power station alone and including the cost of the first section of the plant, $375,000, this works out at $80 per kilowatt installed.

OPERATING COSTS.

Operating costs have been steadily falling with the increasing output and will probably continue to do so for some time. The latest figures obtainable are for the March output of this year. In that month 5,085,430 units were generated, which, deducting auxiliaries, left 4,678,570 units for distribution at the switchboard. The costs are given in the table.

	Per Unit.
Coal	.306
Repairs and maintenance	.092
Salaries and wages	.076
Oil, waste and stores	.006
Office and general	.014
Total	.494 cents

This is not a selected month, in fact, for reasons external to the power station, a portion of the plant was running for the greater part of the month under uneconomical conditions, and the coal bill is above what it normally should have been.

PUMPING APPLIANCES.

The shaft pumps are of two capacities, 12,000 gallons and 6,000 gallons per minute. The lifts are standard at 750 feet, which is suitable to the conditions of these mines. The pumps are mostly of the horizontal type, making forty revolutions per minute with a fifteen-inch stroke. Current is taken down the shafts to operate all pumps at 2,000 volts, and transformed to 120 at the stations. This type of pump needs no apology, but it should be understood that at the time these pumps were specified much difficulty was encountered in getting sufficiently large chambers cut out for them, and the design was influenced by the desire for compactness to specify reduction between the motor and the pump.

AIR COMPRESSORS.

The air compressors, four in number, are located in one station at No. 3 Shaft, from which center the air is delivered by surface mains to the various shafts. Each compressor is capable of raising 5,600 cubic feet of free air per minute to a pressure of eighty pounds per square foot at the receiver, and guaranteed not to exceed 8,000 horsepower at the crank shaft in doing so, the mechanical effciency being ninety per cent.

The intercooler has a cooling surface of 1,200 square feet, and is supplied with cooling water from a special cooling dam adjacent to the compressor station.

The air suction and delivery valves of these compressors are of the Hoerbiger type, and are placed radially at each end of the cylinder, that is, three suction and three discharge valves on the low-pressure cylinder, and two suction and two discharge valves on the high-pressure. The speed of the air through the low-pressure valves is ninety feet per second and eighty feet per second in the high-pressure.

Under these conditions, the rise of pressure in the mains to the receiver is guaranteed not to exceed three pounds per square inch and the drop in pressure on the low-pressure sides not more than 0.5 per square inch below atmosphere when at full speed and load.

These were among the first big electrically operated compressors to be installed on these fields, and owing to the fact that a constant-speed electric drive had beeen decided on, the method of governing, usually affected by speed variation in steam compressors, became very prominent.

When the electrification of Randfontein was first seriously considered, the best method of operating a large compressor electrically was gone into and the conclusion arrived at was that speed control was the most satisfactory. This, of course, meant a Ward Leonard compressor with its converter set, which although presenting no obstacles technically, made a rather expen-

sive outfit. Since that time, however, methods of pressure control at constant speed have been improved, and to-day no one will complain of the regulation of a constant-speed compressor.

HOISTING ENGINES.

All the electric hoists installed on surface are of the Ward Leonard type. There are five main shafts at the Randfontein Central, each of which will be or are equipped with one rock hoist and one man hoist. As the rock hoists have also to transport men at a reduced speed, and the conditions are the same in both cases, the consideration of the rock hoists alone will be sufficient.

The shafts are not all at the same angle, but in order to make for uniformity, the data taken were such that would meet the requirements of any shaft.

Total depth of shaft	2,800 ft.
Vertical depth	900 ft.
Inclined 60 to horizon	1,900 ft.
Max. speed for rock	2,000 ft. per min.
Max. speed for men	1,600 ft.
Total time of trip (rock)	130 secs.
Total time of trip (men)	173 secs.
Interval for loading and unloading (rock)	28 secs.
Interval for loading and unloading (men)	48 secs.
Weight of rock skip	4,740 lbs.
Weight of men skip	4,000 lbs.
Weight of rock	7,000 lbs.
Weight of men	say 28x150 lbs—4,200 lbs.
Weight of rope	2.2 lbs. per ft.

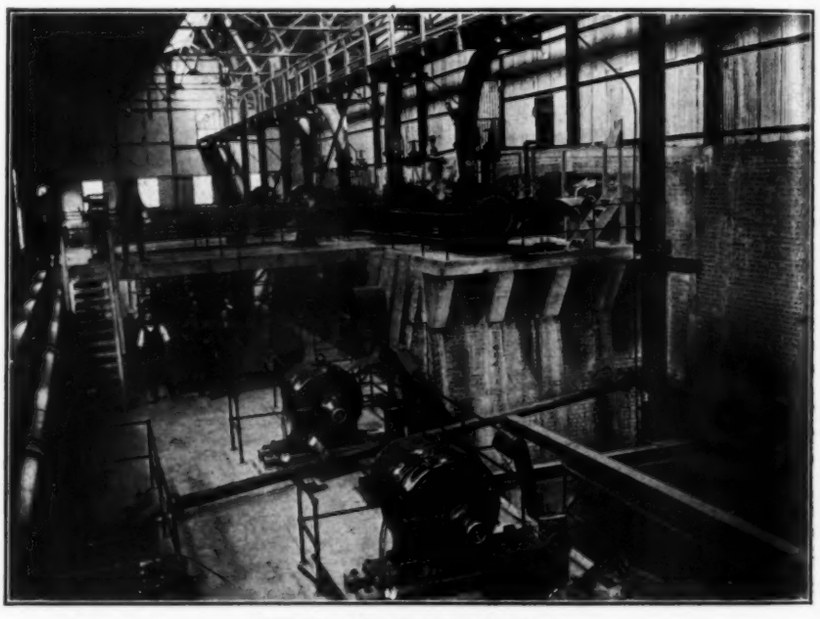
The determining factors in the selection of the type of hoist may be taken as follows: (1.) efficiency and extent of controlling apparatus; (2.) capital and working costs; also, as the power station is owned by the same company, and difference affecting the station must be considered.

The two main systems of heavy electric winding that are considered here are: (1.) by three phase induction motor, in which power is taken without transformation (except perhaps in pressure), from the usual alternating transmission system and conveyed direct to the hoist motor; (2.) by the Ward Leonard direct-current system in which the usual alternating transmission currents are transformed to continuous current before being conducted to the hoist motor.

The first is apparently the simpler, that is, it contains less working parts, but the induction motor is inherently a constant-speed machine, and no method has yet been devised by which the speed, torque and direction of rotation can be regulated or changed at will, with the same facility and efficiency that can be obtained in a direct-current motor with Ward Leonard control.

Efficiency of control is greatly increased if the operator has visual indications of the effects due to his movements of the control lever, and this is obtained with the direct-current system in a very complete manner. This can be seen from the following: The driver operates a lever which is in its "off" position when vertical. Movements on either side control the directions of rotation, and the distance from the vertical indicates to a certain extent the amount of torque, and the speed in both cases when operating normally against a positive load. To assist him in his operations, both types of hoists are provided with an ammeter and a voltmeter, these being generally fixed on a column facing the platform. The value of these instruments in each case may be summed up as follows: In the three-phase hoist the voltmeter indicates whether power supply is on or off, but nothing else. The ammeter, under normal conditions, indicates torque exerted. Under abnormal conditions, such as when exerting torque to retard speed, its indications cannot be relied upon unless the power-factor is known. In the Ward Leonard hoist both instruments have their zero point in the middle of the scale and the indications on both instruments are on definite sides of the zero point corresponding to the direction of rotation. The voltmeter indications are proportional to the speed and could be calibrated in feet per minute. The ammeter readings are always proportional to the torque exerted and the position of the pointer above or below the line indicates the direction for or against the load.

A point requiring consideration is a possible failure of power supply. In such a case a Ward Leonard system could always be designed with sufficient flywheel effect to enable a trip to be completed, whether a negative or positive torque were required. To accomplish the same result in a three-phase hoist, methods have been devised such as running a flywheel generator set, which is kept on the line and automatically cuts itself out and supplies power to the hoist for a short period after power fails. There is also the eddy-current brake for dealing with negative torques. But since the only advantage that the three-phase system possesses over the Ward Leonard is in capital cost, this additional plant required tends to neutralize this advantage.



INTERIOR OF PUMPING STATION.

OPERATING COSTS.

Costs of maintenance will not differ much. Power-cost comparisons can be obtained by constructing load curves indicating the speed and power required throughout the various trips that constitute a day's work.

When working under balanced conditions and normal speed, this difference will not be great, but reduction of speed and negative torque, such as raising men in the first case and lowering men in the second, are greatly to the disadvantage of the induction mo-

tor, and if much of this work is done, working costs alone will decide against it.

Constructing the necessary curve load to correspond with the conditions of running we arrive at the tabulated results shown in the table.

WARD LEONARD HOISTS.

	Total over all efficiency per cent.	Units per shaft B. H. P.	Units per Trip	Cost per Trip at 6c per Unit
Rock Hoisting	49	1.5	13.6	8.16
Men hoisting	31	2.36	13.0	7.8
Men lowering	..	0.159	0.875	.5250

THREE-PHASE HOISTS.

Rock hoisting	47.5	1.55	14.17	8.4
Men hoisting	28	2.62	14.4	8.64
Men lowering	..	2.2	12.1	7.26

The cost of power supply has been taken at forty-four cents per unit which is not likely to be exceeded when under full-load conditions on this group; to this has been added 16 cents equivalent to ten per cent capital charges. Hoisting has been taken from the full depth of the shaft, so that allowance can be made for shorter trips.

The final consideration, though not the least, is the effect of the two systems on the power station. The effect of Ward Leonard hoist peaks on a large station such as the power station of this company is not felt very much yet. The effect will become more marked as the shafts deepen and more hoists are connected, but they are never likely to trouble the voltage regulation at the station.

The Ward Leonard hoist, instead of jumping from zero up to, say, 1,200 horsepower in one sudden rush, rises gradually to this demand, and takes fifteen seconds in doing it. If, as is quite possible, five out of these ten hoists should be accelerating at the same time, that is, within any period of fifteen seconds, the demand on the station amounts to the acceleration power demand multiplied by the number of hoists. Such an event could scarcely be possible with a similar number of Ward Leonard hoists. In order to do so, it would be necessary that all should start at the same instant. When it is remembered that the average load over a day will probably never exceed 3,000 kilowatts per hoist, the effect of possible combinations of load peaks on the capacity of plant required to deal with the general load, may become a serious consideration.

We are indebted to Mr. Butt, the chief electrical engineer of the Randfontein mines for information supplied for this article.

A Tribute to Ralph W. Pope.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers held at the Hotel Sherman, Chicago, June 27, the resignation of Ralph Wainwright Pope, secretary of the American Institute of Electrical Engineers, was received and accepted by the Board to take effect August 1, 1911. The president was authorized to appoint a committee in cooperation with the president-elect to canvass candidates for the office of secretary and report its recommendations to the board of directors. President Jackson subsequently appointed as this committee, Gano Dunn, chairman, H. W. Buck and W. S. Rugg.

A Committee on Resolutions composed of J. J. Carty, chairman, George A. Hamilton and D. B. Rushmore, with power was also appointed by President Jackson under authority of the Board which subsequently made the following report.

For more than twenty-six years Mr. Ralph Wainwright Pope has faithfully and loyally served the American Institute of Electrical Engineers as secretary and for the twenty-seventh consecutive year he has again been elected to the office of secretary. The Board of Directors and the membership at large are of the opinion that by his continuous and honorable service he has attained such a position in the regard and affections of the members of the Institute that he is entitled to some relief from the active executive duties of his arduous position. Therefore, to carry out his own expressed wishes his resignation as secretary has been accepted. In accepting his resignation, the Board of Directors, in order to give expression to their own feeling of gratitude as well as the feeling of the membership at large, and in order to reward such long and distinguished service, has appointed him to the position of Honorary Secretary, in which capacity the Institute may still have the benefit of his long experience in its affairs.

In thus complying with the natural and just desire of Mr. Pope the Board of Directors has thought it well to mark this change by this minute expressing its good will and appreciation, and by pointing out that the term of Mr. Pope's service in the Institute covers many of the most important developments in electrical engineering, and that this period has witnessed the growth of the Institute from the humblest beginning to its present flourishing condition.

At the time when the art of electrical engineering was practised principally in connection with the telegraph, Mr. Pope was a pioneer, having in the year 1858 mastered the working of the Hughes printing telegraph. In 1861 he had charge of the Morse telegraph office at Great Barrington, Mass., in which town he was born in 1844. In 1862 and 1863 he was in the service of the American Telegraph Company in its New York, New Haven and Providence offices, and in 1865 he was one of that band of telegraph pioneers who went into the wilds of British Columbia to establish an overland telegraph system with Europe by means of Alaska and Siberia. In 1867 he was with the Bankers and Brokers Telegraph Company, with whom he remained until 1872, when he became an inspector with the Gold and Stock Telegraph Company. While with this company he was promoted to the position of deputy superintendent in 1880, at which time the apparatus used by the Gold and Stock Telegraph Company was considered by many as representing the highest development then reached by the electromechanical art. While in the service of the Bankers and Brokers Telegraph Company in 1867 he was also assistant editor of "The Telegrapher." In 1882 he became manager of the Union Electric Manufacturing Company of New York. In 1884 he was associate editor of *The Electrician and Electrical Engineer*. In that same year the American Institute of Electrical Engineers was formed. The next year Mr. Pope was elected its secretary, which positon he is about to relinquish. In 1890 he founded the newspaper *Electric Power* and in 1891 he became the editor for electrical terms in the Standard Dictionary. In 1893 under direction of Council, his quarters as secretary were established in the rooms of the American Institute of Electrical Engineers in the Electrical building at the Columbian Exposition, and he was appointed on the Committee of Judges for the Department of Electricity. While at the exposition in Chicago he personally met more than two-thirds of all of the members of the Institute at that time. Ever since Mr. Pope has kept up his large personal acquaintance among the members, which is of great importance to a headquarters official.

During the administration of President Stillwell, Mr. Pope visited a majority of the sections and many of the branches of the Institute and made a study of their development and needs. All of these activities have eminently prepared him for the position of Honorary Secretary, giving special attention to the organization and the interest of the sections and branches.

To Abolish Electric Light Towers.

For many years the two remaining electric towers—the sole survivors of the ten that were erected twenty-five or thirty years ago when Peoria (Ill.) first adopted electric lights—have shed their luster on the territory at Main and North Streets and at Wayne and Glen Oak. Each tower holds four lights, suspended 125 feet in the air. Now Alderman Clarkson suggests that they be torn down and the lights scattered throughout the territory in which they are located. The great trouble with the towers has been that the foliage beneath prevents the light from reaching the street and renders the lights practically useless. He proposes, therefore, to take them down and put the lights where they will do some good. The matter will be called to the attention of the City Council.

Exports of Copper.

Exports of copper for the week ended August 3 were 6,734 tons. Since August 1 the amount was 3,914 tons, as compared with 1,595 tons for the same period last year.

INDUCTION IN ELECTRIC CIRCUITS.

BY H. P. LIVERSIDGE.

This article has been written with the idea in view of explaining in as non-technical a manner as possible, the fundamental causes of electrical induction and its consequent effects on the practical operation of alternating-current systems.

Whenever an electric current flows in a conductor, the phenomenon of induction is present. In direct-current circuits, however, the effects are not so apparent as in the case of alternating-current circuits, where lagging currents and low power factors are the direct consequence of this electrical reaction.

Let us assume a straight wire, AB, as in Fig. 1, connected to an electric circuit, so that a steady flow of current is caused to pass through the wire in the direction indicated by the large arrow. In this case, A will be positive and B negative. The flow of current through the wire causes in turn a field of magnetism to surround the wire, whose strength, according to the laws of electromagnetic induction, is proportional to the amount of current flowing through the circuit.

These magnetic lines of force lie in circular and concentric paths, as indicated in the diagram, and their direction is determined by the direction of current flowing. In the above figure, the direction of magnetic flux is shown by the arrow heads on the circles. If the direction of current flow be changed, the direction of magnetic flux will likewise change.

This magnetic field is what is known as an induced field, and it is this flux that, in turn, reacts on the voltage of the circuit, producing the effects described later.

Let us next assume the wire AB shaped in the form of a ring. In this case, as in Fig. 1, the induced lines of magnetic force still surround the wire in concentric circles. It is clear, however, that the lines of force enclosed by the wire loop are combined in this case in such a manner as to produce a magnetic field of definite direction, thus determining the polarity of the induced field.

The condition of the flux may be better seen by reference to Fig. 2, which is a section of the loop described above. In this figure the direction of the lines of force is indicated. As in the previous case, a reversal of current will likewise reverse the direction of the magnetic flux.

From the foregoing illustrations, therefore, it is evident that whenever a current is caused to flow in a conductor, a field of magnetism is produced—or, more strictly speaking, induced—around the conductor. Its strength will vary in accordance with the strength of the current flowing, and its polarity will be determined by the direction of current in the circuit.

It will also be seen that for a given current, the strength of the magnetic field will depend largely on the shape of the conductor and the surrounding medium. In Fig. 1, the wire was straight and the surrounding medium air. This case is typical of any aerial transmission circuit, and the magnetic field produced will be small in comparison with the circuit in the shape of a loop. Here the lines of force are concentrated in such a manner as to produce a much stronger field with the same current flowing. If the wire or coil of wire incloses or is surrounded by a magnetic material such as iron or steel, the induced field will, in turn, be greatly increased in strength, owing to the path of lower reluctance provided. Thise case may be taken as typical of an electrical circuit composed of transformers, motors, etc., and consequently the inductive reaction in this type of circuit will be of sufficient strength to produce the effects noted in practice.

FIG. 1.

From the foregoing illustrations, we have seen that a magnetic flux is always produced around a wire when a current flows through the circuit. This action is in turn reversible and a movement of flux past the wire will likewise produce an electromotive force in the circuit, causing a flow of current. The pressure of this induced electromotive force will be proportional to the strength of the magnetic field and the speed at which the lines of force are caused to cut the wire circuit. If we create a magnetic field surrounding a conductor, then, according to the laws of electromagnetic induction, the direction of the induced electromotive force or current will be opposite to the flow of current that is necessary to produce the magnetic field in question. Referring to Fig. 1, the direction of current producing the flux is from A to B. If this field of force be caused to cut the wire, so as to become linked with it, the flow of current generated by this action will be in the opposite direction, or from B to A.

The voltage generated in the wire by the passing or cutting of the magnetic lines of force is known as an induced electromotive force, and the current as an induced current.

This phenomenon of induced electromotive force in its most practical application is familiar to all engineers, being the fundamental principle involved in the generation of electricity by the modern type of generators. We have here a set of wires called the armature, so placed in reference to a strong magnetic flux, called the field, that the rotation of one or the other will cause the passing or cutting of these lines of force by the wires on the armature. It is obvious, also, that the electromotive force of the generator, which is identical with the previously described induced electromotive force, will increase as the field strength is increased and the speed of the revolving element is raised.

From the foregoing illustrations we have seen that an induced electromotive force may be produced by a magnetic flux passing a wire, or the wire, in turn, cutting the lines of flux. In either case we have a condition in which the flux surrounding the wire is caused to change in its relation to the wire. This change may be effected by a change in the strength of the magnetic field surrounding the wire. It is evident that, if the wire be surrounded by a strong field of flux, which suddenly decreases to zero, we have a condition which is identical with the case in which the wire passed through a strong magnetic field into a position of zero field.

To be more explicit, suppose the conductor AB in Fig. 1 to be surrounded by a strong magnetic field, produced either by a current flowing in the wire or by an external source. If now the

field, as is indicated in the figure, be weakened to zero, we shall have a condition which will, in turn, produce an induced electromotive force, due to the fact that there has been a change in the relative positions of the wire and flux.

Having pointed out the general principles governing the production of an induced electromotive force or current flow, let us now briefly consider the several reactions that actually occur in a circuit, during the time of closing and opening it.

With the circuit open we have no current flowing, and therefore no induced flux around the wire. Immediately upon closing the circuit, a current is sent through the wire, which, in turn, causes a magnetic flux to surround the circuit. Since this flux has increased from zero to a maximum, it is evident from the foregoing explanations that an electromotive force will be generated in the wire in opposition to the electromotive force causing the current to flow.

Again, when the circuit is broken, the reverse set of reactions takes place. In this case the surrounding flux changes from a maximum to a zero value and, in turn, generates an electromotive force in the opposite direction to the voltage induced when the circuit was closed. In this case we see that the induced electromotive force acts in a direction that would tend to uphold the current. It is this latter reaction which causes the flaming arc when generator fields, shunt coils, etc., are open circuited, and is spoken of as the inductive arc. This electromotive force may reach very high values and depends largely upon the character of the circuit, the amount of current flowing and the speed at which the circuit is opened.

From the foregoing explanations we see that, when a circuit is surrounded by a magnetic field which is produced by a flow of current through the circuit, the only time an induced electromotive force will be generated is when there is some change in the strength of current flowing. In circuits carrying steady currents this effect must be nil, except at the time of opening and closing the circuit.

In commercial alternating-current circuits, however, such is not the case. We have here a rapidly changing current which fluctuates between a maximum and zero value, 3,000 or more times a minute. Since the magnetic flux surrounding these circuits must also follow the current changes, it is evident that the induced electromotive force will be of considerable value, especially in circuits containing large coils of wire with iron cores, as in the case of transformers, motors, etc.

It is also evident that since the current flowing in the circuit is alternating, the induced electromotive force will also be alternating. This electromotive force reacts on the voltage of the circuit, producing the effect spoken of as low power-factor or lagging current.

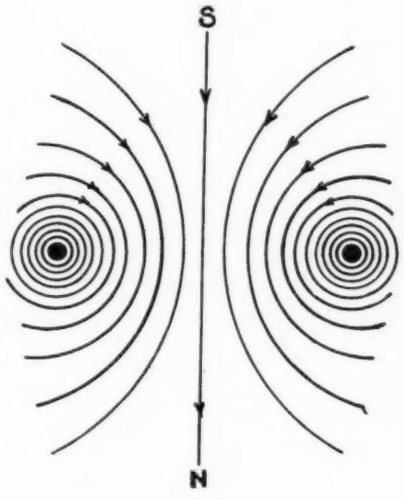


FIG. 2.

Having thus far considered the fundamental reactions of an inductive circuit, let us next take up in detail the actual conditions existing in a circuit in which an alternating current is flowing. Referring to Fig. 3, let the alternating electromotive force impressed on the circuit be represented by the heavy curve ABCDE. This curve may be said to indicate the instantaneous values of the generator pressure during one complete cycle. In this particular illustration we have assumed an ideal circuit in which there is no inductive effect present, the frequency being sixty cycles and the maximum pressure one hundred volts. It is evident that since the frequency is sixty cycles per second, the time for one complete cycle will be one-sixtieth of a second. In Fig. 3 the distance from A to E represents the time of a complete cycle, and the distance A to C, one-half cycle, or one alternation. Starting at the point A and keeping in mind that vertical values indicate the electromotive force of the generator at particular instants, we see that the voltage gradually increases in strength from zero to a maximum positive value at B. This maximum has been assumed as 100 volts. From this point the pressure of the generator decreases until it is again zero at C. From C to E the voltage again passes through a series of changes similar to the first alternation or half-cycle. In this alternation, however, the voltage values are negative in direction. From E the values will again pass through a similar series of changes as indicated in the cycle starting at A.

In the time indicated by the space AE, the pressure of the circuit has changed from zero to 100 volts positive, to zero, to 100 volts negative, and again to zero. Let us assume that the load on the generator is such that, at the point of maximum voltage, the current flowing through the circuit will be fifty amperes. We can now plot the curve that will indicate the instantaneous value of the current flowing. This will take the general form indicated in Fig. 3 by the dotted line. At A the current will be zero, since the voltage at this point is also zero. From this point the current gradually rises with the increase in electromotive force to its maximum value of fifty amperes at B, then decreasing in strength until it is again zero at C. Likewise, the change in current strength during the alternation from C to E will also occur at the same period of time as the voltage values, and as indicated will be negative in direction.

From the foregoing it is evident that when there is no inductive action in an alternating-current circuit, the current value rises and falls in unison with the electromotive force of the alternator, and it is said to be in phase with the impressed electromotive force. Such a condition, however, may be said to be ideal and seldom occurs in practice, for, as we have already seen, there must always be a certain strength of magnetic field surrounding the current carrying conductors. This field, under certain conditions, may be very weak or unable to induce an appreciable inductive electromotive force in the circuit, in which case the effect on the generator is so small that practically the circuit may be considered as non-inductive.

Such a condition of non-induction is closely approximated in alternating-current circuits where the load is composed entirely of incandescent lamps. In this case we have a circuit free from any coils of wire or surrounding magnetic material, so that the number of lines of force surrounding the wires will be small, a condition previously noted in Fig. 1.

In commercial circuits, however, transformers, motors, heating coils, etc., are always included in the connected load, so that we are certain to have an appreciable magnetic field surrounding the current-carrying wires of the system. The instantaneous value of this flux is proportional to the current flowing at that instant of time, when there is no magnetic material present. It is evident, therefore, that any change in the current strength will produce a corresponding change in field strength. Referring to Fig. 4, the dotted curve represents the instantaneous value of current as indicated in Fig. 3. Since we have seen that the number of lines of force surrounding the circuit wires is dependent on the current flowing, it is also clear that the magnetic flux may be represented by the dot and dash curve indicated in the figure. This curve is also alternating in character and in phase with the current flowing in the circuit. In other words, at A, when the current is zero, the magnetic flux will also be zero. As the current increases, the strength of the surrounding field will also increase, until both have reached a maximum together. As the current gradually decreases, the flux will likewise decrease in strength, and again reach a zero value at the same instant as the current wave. It is evident that this rapidly alternating field of force will in turn generate an induced electromotive force in the circuit that will produce the condition known as lagging current or low power-factor. When there is iron or steel present, the magnetic flux is not in phase with the current, but lags behind it in passing through the zero values.

In order to clearly show the production of this electromotive force by the alternating flux, let us refer to Fig. 5. The curve AMCNE is an enlarged detail of the curve of flux values as shown in Fig. 4 by the dot and dash curve.

According to the law of electromagnetic induction, we have seen that the production of an electromotive force by the cutting of lines of force is dependent on the number of lines cut per unit of time. In other words, the induced electromotive force is proportional to the speed at which the flux surrounding the wire changes in value. An examination of the curve of flux in Fig. 5 will show that at A the change is very rapid, while at M the rate of change in field strength is zero. In order to bring this point out more clearly, assume a distance AK equal to one-eighth of an alternation or 1/960 of a second. Durin this period of time the flux has risen from a zero value to a value equal to 0.38 of the maximum value of flux strength. If we consider the change in magnetic flux during a similar interval of time, as indicated by ST, embracing the point of maximum flux, we can readily see that there is practically no change. It is evident, therefore, that the induced electromotive force generated will be a maximum at the points A, C, etc., since the flux is changing most rapidly at these points. Also, the induced voltage will be zero at the time of maximum flux, since the rate of change in field strength at these points is zero. The curve of induced electromotive force can, therefore, be drawn with reference to the curve of flux values. The dotted curve, PQR, Fig. 5, indicates the different values of this induced electromotive force in reference to the alternating flux generating it. It is clear, also, that this induced electromotive force will be an alternating voltage similar to the generator voltage. In the figure we have assumed a flux value such that the maximum value of the induced electromotive force will be ten volts, as indicated in the diagram.

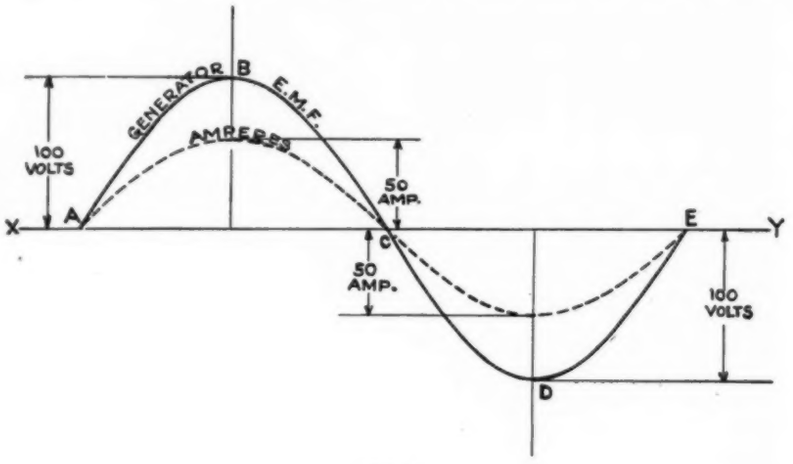


FIG. 3.

Since this electromotive force must now be considered as acting in the same circuit indicated in Fig. 3, it is evident that the original generator voltage will now be called upon to overcome this electromotive force, while at the same time, forcing current through the circuit. In other words, the generator voltage necessary to supply this circuit will now be the resultant of the electromotive force needed to overcome the resistance of the circuit in forcing current through the line and the voltage necessary to oppose the electromotive force of self-induction.

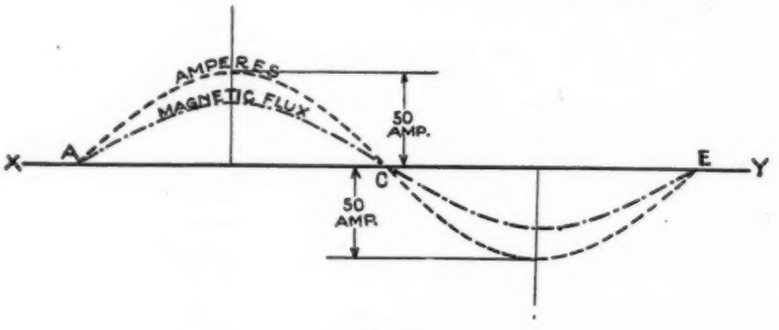


FIG. 4.

It is evident, therefore, that if this induced electromotive force is imposed on the circuit, the instantaneous values of the generator voltage will now have to be different to compensate for the self-induced electromotive force in the line. In other words, at the point A, for the same pressure to be acting in forcing the current through the line, the generator electromotive force will

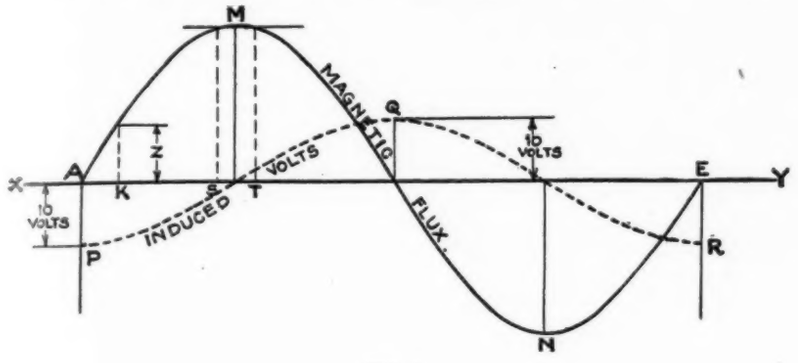


FIG. 5.

now have to be ten volts positive. From this point the increase in voltage above the original generator pressure will gradually diminish until, at B, Fig. 3, the generator pressure will be the same as the electromotive force of the circuit when no induction was present. If, therefore, we algebraically add the values of the voltage which produces current and the voltage necessary to overcome the induced pressure, we will obtain a new voltage curve, as indicated by the solid line in Fig. 6, which is the pressure of the generator necessary to force the assumed current through the circuit. This generator voltage is called the impressed electromotive force and is the resultant of the active electromotive force—the voltage of the circuit when no induction was present—and the electromotive force of induction.

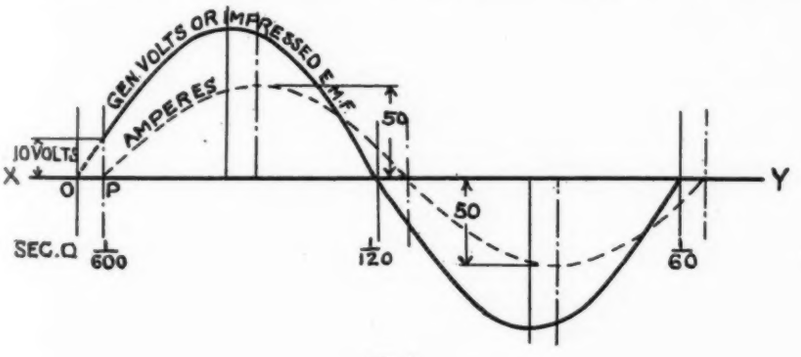


FIG. 6.

Referring again to Fig. 6, we see that the generator voltage or impressed electromotive force does not reach its maximum and zero values at the same time as the current wave. In other words, the generator electromotive force is not in phase with the current in the circuit, as was the case in Fig. 3, when no induction was present. It is also evident that, since time values are measured from left to right, the zero voltage at O occurs earlier than the zero value of current at P, in this case the elapsed time being about 1/600 second. The electromotive wave is, therefore, leading the current wave, or the current is said to be lagging in reference to the impressed electromotive force of the circuit.

It is clear that the active electromotive force of the circuit, which is of use in forcing current through the lines, will now be less on account of the induced electromotive force, so that, in order for the generator to supply the same watts output, the current will have to be increased in value. The greater the induction in a circuit, the higher is the induced electromotive force and the smaller the value of active voltage which is available for forcing current through the circuit.

The phase relation existing between generator volts and current is usually spoken of in terms of per cent power-factor. In practice, this value may vary from 100 per cent, where no appreciable inductance is present, to 45 or 50 per cent on very poorly loaded induction-motor circuits.

In order to determine the power-factor of any circuit it is necessary to have an ammeter, voltmeter and wattmeter connected, so that simultaneous readings may be taken of each instrument. The product of the amperes and volts, when divided into the mattmeter reading, will give the result desired. expressed in the form of an equation, we have:

$$Power\text{-}factor = Watts/I\,E$$

The product $I\,E$ is commonly spoken of as the volt-amperes of the circuit and is equal to the indicated watts when the power-factor is 100 per cent or unity.

As an example, let us assume a 2,000-volt single-phase alternating-current circuit supplying a load of 150,000 watts with the ammeter reading 100 amperes. In this case the power-factor will equal $150{,}000 \div (2{,}000 \times 100)$ or 75 per cent.

In the above example, if there had been no induction present in the circuit, it is clear that the product of volts and amperes as previously explained would equal the indicated watts, and for a definite power output the current flowing would be only seventy-five amperes, a value that indicates a condition in which the voltage and current waves of the circuit are in phase with each other.

In general, therefore, it may be said that, if a stated power is to be delivered, an increase in the inductive electromotive force of any circuit will require an increase in the current flowing and a corresponding increase in the difference between the volt-ampere readings and the actual watts.

Wireless in Forest Patrol.

Assistant Chief United States Forester, William Potter, will recommend that wireless telegraphy be used instead of the telephone in connection with the patrol of the great forest reserves of the West.

A Long Telephone Cable.

A cable fifty-six miles long, which is said to be the longest submarine telephone cable in the world, will be built by the British Post Office from Holyhead to Ireland.

Electrical Notes From Great Britain.

By Our London Correspondent.

The congress of the Tramways and Light Railways Associatian, held at Edinburg on July 13 and 14, considered some of the reasons why electric traction in England remains stationary. G. H. J. Hooghwinkel, who opened the subject, detailed a number of matters which he considers will have to be radically altered if tramway enterprise is to be continued in England on a sound commercial basis. He holds that our tramways cost too much to construct and too much to run. The latter is largely influenced by the former, seeing that the capital and maintenance charges are in all cases a considerable part of the working costs. Cost of construction will have to be entirely altered if tramway business is again to become a safe and popular investment in England, as it is in most European countries. Mr. Hooghwinkel sought to prove that the reduction of construction cost would go hand in hand with a reduction in operating expenses, such as repairs, maintenance, power, costs, etc., and need not interfere with the aspect of the installation or the safety of the undertaking. How to construct the ideal permanent way, the advantages of the sliding-bow trolley improvements, in detail in car building, etc., indicate the lines along which the author holds that future tramway practice will run. C. W. Mallins, manager of Liverpool Corporation Tramways, followed with notes on tramway problems. He said that an examination of the cost of construction of permanent way and overhead equipment per mile of single track on the different systems in the United Kingdom disclosed amazing variations, even where the conditions were similar. In regard to the best type of car for present-day requirements, Mr. Mallins gave reasons why he regarded the single truck as the most suitable and economical. He says that the single-truck car of the newer type with seven feet six inches or eight-feet wheel base may be the car of the future in this country, as it has now been demonstrated that it is quite practicable to increase the length of the wheel base of single-truck cars without much disadvantage in operation. Mr. Mallins favors the cultivation of good traffic on tramways, both in the interests of the tramways and of manufacturers and traders. Alderman Ivey, discussing the future of tramway legislation, gave his ideas of a number of amendments that he considers desirable in the present acts. C. W. Shepherd, in bringing forward the subject of transfer fares, expressed the conviction that where transfers are judiciously issued they are remunerative to tramways, because it is an inducement to a passenger to take a penny transfer if he thinks he is going to get good value for his money, even if in many cases the second portion of the journey is never completed.

A number of electric and tramway companies, during the past few years, have inaugurated bonus schemes whereby employees, of certain classes, have received allowances for economies in fuel consumption in the case of electric generation, and for good conduct and freedom from accident in the case of tramway operation. The schemes have been more or less experimental. At West Ham, where there are 175 motormen and 177 conductors, the total payments for the past year have been $3,675. The percentage of employes gaining bonuses has been high, for of the motormen 81.50 per cent benefited quarterly to the amount of just over three dollars apiece. There have, however, during the year, been advances in the wages and increased holiday privileges, and it is announced now that the bonus scheme is to be discontinued.

H. E. Blain, the manager of this system, in his very interesting report just issued, shows that to equip twenty-five of his trolley cars to run also on the London County Council conduit system has cost $166 per car. A number of these cars had the side frames of the trucks lengthened so as to make them all seven feet from wheel centers, and all had to have flooring and bottom construction altered to give access to the plough and collector gear. The whole of the wiring was altered for both positive and negative, and the cars fitted with change-over main switches. Special efforts have been made to alter truck design in order to overcome the galloping of the cars and the hogging of the bodies which damaged pillars, panels, etc. These troubles are aggravated at West Ham owing to the amount of single line and loops and to the latter being fitted with short points. A truck of entirely new design has now been built of standard rolled bars and sections, the brake gear, wheels, axles, axle boxes, springs, etc., being interchangeable with the ordinary trucks, the only new fittings required being the cast-steel horn blocks, keeps and truss brackets. Parts have been much reduced in number, springs being halved, and all parts likely to require attention are well exposed.

A number of tramway authorities are announcing the benefits derived from the use of meters on cars. Croydon, running seventy cars so fitted, reports a total saving for the past year of 24.77 per cent, or close to $25,000. T. B. Goodyear, the manager, has prepared a special report on the experience of many tramway managers in different parts of the Kingdom with the use of car-meters. The Wigan tramway system has saved in a few weeks .07 of a kilowatt-hour per car-mile, aggregating $750 in nine weeks.

Mr. Dalrymple, manager of Glasgow Corporation tramways, and his committee, have just issued their usual very detailed report for the year, from which is extracted the following: Total income, $4,747,445; working expenses, $2,665,895; net revenue, $2,081,550. The increase in revenue was $292,365. While income was 20.9 cents as compared with 20.4 cents, working expenses showed an advance of only 0.281 cents per car mile. After financial charges are met depreciation fund absorbs $585,650 and permanent-way renewal fund $427,250.

The capital expenditure stands at $17,515,870. The system is 196 miles, reckoning single track, with 803 cars in stock. The addition of top-covers is continuing; a large number are now being fitted, making 743. A number of cars are being fitted with current meters. The cost of granting free traveling facilities to the blind residents in the city of Glasgow is about $2,750 per annum. The entire population is carried 206.93 times per annum. The percentage of working expenses to receipts was 53.70, as compared with 53.82 in the previous year.

Some of our electrical manufacturing companies are showing improved results. The Electric Construction Com-

pany, Limited, reports a better demand for electrical machinery and a marked increase in net profit during the past year, due only very slightly to better prices and chiefly to increased volume of business and reduced cost of production. The report is hopeful as to the future "if the present demand is maintained." For the first time in many years the ordinary shareholders share in the profit, though only to the amount of two and a half per cent. The General Electric Company, Limited, of London, has had a record year, but it has only distributed five per cent on the "ordinary" capital, applying very large share of the profits and part of the already existing reserve fund to the writing down of good will and patents.

There is to be a very thorough investigation made by a committee of twenty-eight experts—fourteen representing textile and electrical interests respectively—of the application of electricity in textile mills in England, Europe and America.

A great deal of attention is being devoted to the "telephone transfer" question, both in the courts and out of them. There has been much interesting argument and expert evidence on the point of "suitability" of certain equipments for the needs of the Postmaster General, but not much need be said on this now, as the postoffice has agreed to take over the whole national plant. The misgivings which some of the National Company's staff and employees had regarding their future have been removed by a statement of policy made in the House of Commons by the Postmaster General. Their rights and privileges will be faithfully regarded. The House of Commons is, under the new bill just approved, authorized to spend an amount not exceeding $20,000,000 for the extension of the telephone system.

The annual report of Marconi's Wireless Telegraph Company shows quite a different state of affairs from that revealed by any previous report during its entire history. The profits earned on its business and received on its shares in subsidiary companies enables all dividend to date to be paid. Among many interesting remarks in the report were the following: "Application has been made by Marconi . . . for patents for a new and what is believed to be a very valuable invention, consisting of a new duplex system adapted to wireless telegraphy. This invention has been submitted to a practical and thoroughly successful test at the Clifden trans-Atlantic station." After referring to the result of the litigation during the past year regarding the "four sevens" patent, the report says: "This patent is of paramount importance. No wireless station of any practical utility can be erected without infringing this patent.

It will be the policy of the directors vigorously to maintain the company's rights—both at home and abroad." The future policy of the company lies mainly in long-distance commercial service, day and night, and "negotiations of an important nature are pending to erect and work a chain of wireless telegraph stations around the world." The foregoing statements were amplified considerably by Mr. Marconi in a lengthy speech at the shareholders' meeting on July 20. He said that on the occasion of his visit to Buenos Ayres last year he experimented on the way with the Clifden and Glace Bay stations. Success was obtained at different distances, and right up to the arrival at Buenos Ayres, in receiving messages from both stations at a distance of over six thousand miles. The Argentine Marconi Company will now proceed with the erection of its long distance station, which will put South America into commercial wireless communication with Europe. Mr. Marconi said it was the English Company's policy to erect long-distance commercial wireless stations throughout the world and to remain interested in their working.

It is announced that as the result of a visit of the Postmaster General to America, the Strowger and Lorimer automatic telephone systems are to be experimentally introduced for two small exchanges (500 lines each) at Epsom and Caterham (Surrey). A 400-line automatic exchange is also to take the place of another at Saint Martins le Grand, to serve the Postoffice Official Department.

ALBERT H. BRIDGE.

London, July, 1911.

Wireless Telegraphy in the Kongo.

A report from an American consular agent in Belgium Kongo, Africa, states that a wireless expedition left Belgium for the Kongo several months ago. This expediton was organized by M. Goldsmith, of Brussels, for the King of Belgium, who has allotted for the purpose part of a fund of $636,900 to be used each year for the improvement of the Kongo.

The purpose of the expedition is to erect several experimental wireless stations and test the practicability of establishing wireless communication with Europe and extending the system throughout the territory of the Kongo. It is believed that wireless will be better suited to the conditions of this vast country than the wire system, on account of the great stretches of jungle and marsh, where wiring is extremely difficult, and on account of the ravages of storms and wild beasts, especially of elephants, who seem to delight in pushing over the poles.

The expedition consists of six men, representing two different companies which are competing for the contract for the complete installation of wireless in the Kongo. These companies are the Telefunken of Berlin and the Radio-Telegraphie of Paris. The former system has now been installed at Boma, about fifty-five miles up the Kongo River, and the Radio-Telegraphie system at Banana, at the mouth of the Kongo. Two more stations are to be installed by the Telefunken, one at Leopoldville, about 220 miles up the river, and the other at St. Paul de Loanda, the capital of the Portuguese province of Angola, about 200 miles south of the mouth of the Kongo. The stations at Boma and Banana are now in operation and have succeeded in establishing communication with each other and with vessels at considerable distances at sea. Within two months it is expected that regular communication will be established between all four stations.

It is interesting to note that the steamship *Elisabethville*, used on the voyage noted above, carried the first steamship wireless installation to the Kongo. The system used on the *Elisabethville* is the Marconi, and for the first two trips was in charge of an expert operator, sent especially to study the conditions in the tropics. He reports that atmospheric electricity by night and the effect of the sun's rays at certain times by day make long-distance communication impossible in the tropics, but that there are times, notably at about 5 or 6 a. m., when these disturbances are at a minimum and long-distance messages can be received. A few years ago it was considered impossible to use wireless in the tropics, but now, with perfected instruments, we may soon hear of man's latest means of communication serving in the wildest and least known parts of the globe.

Electrical Notes from Continental Europe.

By Our Paris Correspondent.

During the Turin Exposition there is to be held an International Congress of Applied Electricity which will last from the 10th to the 17th of September. It is organized by the Italian Electrotechnical Association and other bodies of a like nature. The several sections of the congress relate to electric machines and transformers, electric plants and wiring, instruments and apparatus, lighting and heating, electric traction, telegraphy, telephony, electrochemistry, also tariffs and legal questions. An interesting part of the program will be visits to the most recent electric plants in Italy.

American engineers are well represented among the papers which are to be read before the congress. A number of these papers will review the present state of affairs in various fields. Philip Torchio, of New York, will treat the question of parallel operation of several central stations working in the same network of lines, and the proper voltage to be used in laying out switchboards and substations; also the cost of operating central stations. G. Faccioli, of Pittsfield, will read a paper on the question of excess voltages and protection of lines. Single-phase and three-phase traction will be presented by F. J. Sprague, regarding trunk lines especially. H. C. Sharp of New York, will treat the subject of electric meters, and F. B. Jewett long-distance telephony.

One of the most recent of the Swiss electric railroads is the one which is now running between Martigny and Orsieres. The former locality is a railroad station on the Swiss Federal Railroad which runs along the Rhone valley to the Simplon tunnel. The electric line runs about at right angles to the railroad and follows the St. Bernard route for a part of its course through the mountain region, ending at Orsieres at present, but it may be extended later on to Aoste. The road is a short line of twelve miles, but is of standard gauge and is designed to take a considerable amount of freight as well as passengers. The highest gradient is 3.5 per cent. Designed on the single-phase system, the line uses 8,000 volts on the trolley wire, at twenty-five cycles. Trains are made up of a motor car of the four-axle type, of forty tons weight, containing forty-eight seats with a baggage compartment, and several trailers. For the freight trains there is used a motor car of thirty-five tons which has a freight compartment for ten tons load and a sixteen-seat passenger space, also a number of trailers. Each of the motor cars is fitted with four motors, and these are designed in a somewhat novel way, using the Déri system in which the motors are operated by shifting the brushes. The present motors are of the eighty-horsepower size. What is to be remarked is that all the usual operations needed for handling a motor car, such as starting, speed regulating and reversal, are carried out by shifting the brushes around the commutator, using a suitable mechanical device for doing this. A switch in the stator circuit completes the apparatus and this is therefore less complicated than usual. The voltage used on the motor is 750 volts, and this is obtained by two transformers mounted on the car, with 8,000-volt 750 ratio. On the roof are two pantagraph trolleys working on an eight-millimeter wire with simple or catenary suspension.

Seeing that the Swiss railroad administration has decided to adopt electric traction upon all its lines in the near future, it is engaged upon a number of projects in order to secure the needed amount of water power. It has already obtained a number of concessions in the Simplon region, as well as in the neighboring cantons and expects to secure others before long in the region of Mont Blanc. In the latter case the power of the Rhone will be called upon for a considerable supply, and it is likely that a hydraulic plant of large size will be erected between Fiesch and Mörel. On the St. Gotthard section there is already being carried out some extensive hydraulic work, and this will give enough power to allow of operating the portion of railroad lying between Lucerne and Chiasso. It is estimated that this work will give at least 30,000 horsepower. Other plants are to be erected in the region lying on either side of the St. Gotthard tunnel.

Among the recent municipal electric stations to be operated in Germany we may mention the plant which has been erected for the city of Strasburg. This is the second station to be built for the light and power supply, seeing that there was already a 12,000-horsepower plant in operation, but this proved to be insufficient, hence the new station was installed in another part of town. When all the machines are erected it is to have a total capacity of 30,000 horsepower or more. All of the electrical work is carried out by the Allegemeine Elektricitäts Gesellschaft. At present here are three steam-turbine units in operation. One of these is a 3,000-kilowatt unit, and the other two are of 1,100-kilowatt size. The station is operated on the three-phase system at 3,000 volts. There is soon to be added a fourth steam-turbine set of larger size, rated at 6,000 horsepower. The turbines are of the A. E. G—Curtis type, built at the Berlin factories of the company, and are operated with surface condensers. In the boiler room are erected six Steinmüller boilers of 4,000-square foot heating surface, fitted with superheaters working at a normal temperature of 300 degrees centigrade. A part of the dynamo building is constructed of reinforced concrete.

A number of sections of the state railroads in Baden are to be operated on the electric system before long, and current will be secured from a hydraulic plant of considerable size which is expected to yield at least 25,000 horsepower. The Isar River furnishes the quantity of water which is required. A dam is erected on the stream at Hochgraben, and a two-mile flume brings the water to the lake of Walchsee which is used as a regulating reservoir. From the lake there is a short flume leading to the main settling basin which overlooks the turbine plant. This latter is located not far from the Kochelsee and has its tail-race flowing into this latter. In the station are erected a number of Pelton turbines of 10,000 horsepower size. As there will be used but a part of the total capacity of the plant in order to supply the electric railroad sections, means have been provided for delivering the rest of the current to a power network running through the region.

Professor Schreiber, of Griefswald, is making some experiments in order to improve gas engines. He seeks to increase the gas compression, as is done in the Diesel oil engine, but in the ordinary gas engine this cannot be increased above a given point, as the gas will be ignited by the great heat which the

compression gives, and this causes the engine to run badly. The author sends a fine water spray into the cylinder at the right time, and in vaporizing, the water absorbs a certain amount of heat, so that the temperature is kept down within the right limits. His tests with a ten-horsepower motor designed on this principle have so far been very encouraging.

Electric traction is to be used on the Mont Cenis railroad section lying between Modane and Bardonecchia. The work of installing the electric equipment is now being carried out. Current is to be secured from the city station of Turin, and the railroad administration has lately made a contract with the municipality to that effect. There are being erected two substations for feeding the railroad line, and these are located at Chiamonte and Salbertrand. Among other electrical enterprises in Italy we may mention the project for a single-phase electric railroad to be run from Turin to Ponevalo.

Mr. Seldman read a paper before the French Physical Society upon the influence of the frequency of the current upon the production of ozone. His experiments bore upon ozonizing apparatus in which the discharges are made without dielectrics. The effect was found to be quite variable, seeing that some apparatus gave more ozone at 500 cycles than at 100 or less, while other types of construction showed as good results with 10 or 100 as with 500 cycles. He concludes that the amount of ozone does not therefore depend upon the frequency of current which is used.

The first telephone exchange to be installed upon the automatic system in Europe is erected at Munich. It is the second of the two exchanges in the city, and is now fitted with apparatus for 2,500 subscribers which can be increased to 5,000 later on. The automatic apparatus occupies the second story. The lines enter the basement and are taken up to a distributing board placed in the floor above, from which they go to a second distributor and thence to the automatic part. Current at 220 volts comes from the city mains and there are two motor-generator sets used one for battery charging at seventy volts and the second to give seventy-volt, twenty-five-cycle current for the call bells. The machines and storage batery are installed in the basement.

A DE COURCEY.

Paris, July 26, 1911.

ELECTRICAL INSTRUCTION AT TUSKEGEE INSTITUTE.

BY HENRY K. CRAFT.

The leaders in educational thought in this country are practically unanimous in their opinion that one of the greatest needs of the south is the industrial education of the colored people. Notwithstanding the crying need for industrial education among the colored people of the south, but few of their schools have carried the work to the extent that they might, although nearly every institution has manual training of some kind established in its courses. One of the institutions of the southland that has established a very practical course in electrical instruction for the colored men is the Tuskegee Normal and Industrial Institute at Tuskegee, Ala. The object of this course is to teach not only the actual mechanical considerations of the job, but the underlying electrical principals that are being applied as well. An effort is made to have the course follow a definite line of development, starting at the bottom and working for a predetermined end. It must be borne in mind that the work cannot become more technical that the academic training of the students permits.

The work is divided into a course of three years. In the first year conductors and insulators are studied and demonstrations and simple experiments made upon the effect of current in conductors and fuses, experiments in electro-magnetism, definitions and derivations of the fundamental units, examinations of open and closed circuits, experimental work on fall of potential on long and short conductors, and examination and experimentation in the operation and construction of arc lamps. The practical work includes telephone and transmission-line work, testing out simple troubles in telephone lines, assisting on repair jobs in the laboratory and on interior wiring jobs, running simple bell and annunciator circuits, and working upon the connections and maintenance of the street-lighting circuit.

The second year course takes up the study of the principal parts of the dynamo and their functions, the construction of the commutator, armature winding of various types, the study of higher equations and the analysis of the characteristic curves of series shunt and compound-wound machines. The operating efficiency of various machines is studied and the practical work includes interior wiring jobs, testing and repairing of the dynamos and motors, estimating on jobs, and the students in the second year course assist in giving instruction to the first-year students.

The third year takes up the study of alternating-current apparatus and alternating-current phenomena including insulation testing, switchboard construction, design and operation of the transformer and transformer tests, and the practical work includes the care and maintenance of the whole plant, the students acting as repair men, trouble men, and assisting in the teaching of the night classes.

The power plant of the school gives the student an opportunity for experimental and practical work, and in this respect does quite as well as a more elaborately equipped laboratory. There are about twenty large brick buildings and thirty residences supplied with current, the wiring and fixtures in all cases being installed by students. There are also about 160 street lamps in service on the ground, including both incandescents and arcs. The generating plant consists of three units—an old General Electric monocyclic alternator, a 150-kilowatt alternator of the same type, both generating current at 1,140 volts. There is also a three-phase revolving field 150-kilowatt alternator. This was installed last year. The first two machines are belt-driven and the new alternator is direct connected to its engine. When this equipment is augmented with a fairly well equipped laboratory, which will contain apparatus that the plant does not now possess and which will familiarize the student with the operation of apparatus with which he will come in contact when he gets into a broader field, it is hoped that the institute will be in a position to turn out some first rate, intelligent men for taking up the electrical work which lies all about them.

Electric Power in Placer Mining.

The Manhattan, Nev., placer mines make use of electric power in hoisting the pay gravel to the surface. Power is supplied at a flat rate of $2.00 per horsepower-month, with an additional rate of three cents per kilowatt-hour, after a certain amount has been exceeded.

Central-Station Practice

THE SILS-ZURICH TRANSMISSION LINES.

BY ALBERT SCHEIBLE.

In planning to transmit electrical energy to the city of Zurich from the newly erected hydroelectric plant on the Albula River (one of the Alpine tributaries of the Rhine), the authorities aimed first of all to secure dependability of service, so as to avoid the necessity of a reserve steam or storage-battery plant. It was therefore decided to divide the needed line capacity, distributing it over two entirely separate pole lines run along opposite sides of Lake Zurich.

FIG. 1.—RAISING POLES OF REINFORCED CONCRETE.

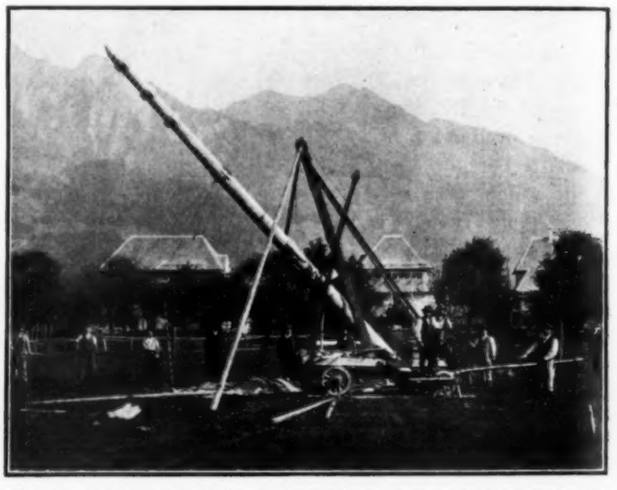


FIG. 2.—SETTING TUBULAR CONCRETE POLE WITH DERRICK.

The total normal output of the turbine plant, consisting of eight turbo-generators of 3,000 horsepower each, was estimated at 20,600 horsepower, or an available 13,895 kilowatts. Of this output, some 300 kilowatts would be needed for free service to the communities from which concessions had been obtained for the hydraulic plant, leaving approximately 13,500 kilowatts to be transmitted over the long-distance lines.

Calculations made when the system was first projected, showed that for the same investment in copper and the same transmission losses, an initial voltage of about 47,000 volts would be ample for a polyphase system as against 79,500 volts for direct current. Consequently, it was decided to erect four three-phase circuits, it being thought wise to keep the transmission voltage just as low as an advisable transmission loss would permit. Using wires of about 250,000 circular mils and assuming a power-factor of eighty per cent, this meant an initial voltage of 46,000 at the generating station for a line loss of 13.8 per cent and a delivered voltage of 40,000.

Each pole line was therefore planned for carrying six wires of 250,000 circular mils, though for the time being one division of the circuit has only been strung with three wires, leaving the other three to be added as the required lighting load increases. On this three-wire pole, the conductors are arranged in the form of an equilateral triangle with one side of the triangle vertical; on the other pole the six conductors form the corners of an equilateral hexagon having sides 32.5 inches long.

In order to utilize the duplicate pole line to good advantage, four switching stations were erected along the line at spacings of about 12.5 miles from the generatng plant. The total transmission distance between the Albula power plant and the city of Zurich is about eighty miles, but the lake of the same name prohibits a cross-connecting during the last thirty-mile stretch on each side of it. These switching stations allow the circuits on both pole lines to be connected in multiple and also allow any section of a line to be disconnected in case of trouble. When not widely separated by the intervening lake, both portions of the circuit follow the valley but are never allowed to come closer than within forty-eight feet of each other.

Realizing that the dependability of the whole system would hinge to a considerable extent on the pole line, the engineers in charge of the system decided early in their planning to avoid the use of wooden poles entirely. At that time the reinforced-concrete poles erected in Zurich in 1903 were already giving satisfaction and the experience with them influenced the authorities strongly in their favor. However, the formal specifications were not limited to concrete, but gave bidders the option of figuring on poles made of steel, reinforced concrete or any other combination of iron and cement. The specifications were based on the following assumptions:

(a) That the strain due purely to the weight of the line wires should not exceed twenty per cent of their tensile strength, i. e., should not go over 5.4 kilograms per square millimeter.

(b) That on straight pole lines, the poles should be designed to stand a side strain of ten per cent of the pull of the wire, figured as above.

(c) That the wind pressure should be estimated as twenty-five pounds per square foot on surfaces square to the

wind, or seventeen pounds per square foot on cylindrical surfaces. Snow or sleet clinging to the wires was not to be considered and in calculating the wind pressure on the poles, the wires were to be treated as rigid connections.

(d) The effective center of pull of the wires was to be assumed to be at the height of the central pair of insulators and the average spacing of the poles as 197 feet (60 meters).

(e) The setting of the poles in the ground, regardless of the soil at each point, was to be such as to give a factor of safety of at least one against their tipping in any direction.

As the result of the competitive bids, four different types of poles were adopted for different portions of the transmission lines:

(1) Reinforced-concrete posts with an I-shaped section. These were furnished partly by Favre & Company and partly by Gossweiler & Company, all being the so-called "Jaeger" type of poles. They were erected by a gang of twenty men, using poles fastened in pairs to suitable stirrups, as shown in Fig. 1.

(2) Reinforced-concrete poles with ring-shaped cross-sections and with enlargements against which the wooden cross-arms would bear. These were partly the so-called "Siegwart" poles of the Swiss Siegwart Pole Works at Rheineck and partly the "Locher" poles from Losher & Company. Fig. 2 shows the former type in process of erection, a horse-drawn derrick being used for this purpose.

(3) Tubular poles of Mannesmann tubing, furnished by Bosshard & Company of Nafels.

(4) Latticed steel poles, supplied by the last named firm for use at corners where the strains were abnormally heavy. These were set in massive concrete bases, as shown in Fig. 3.

The tubular and latticed poles formed only a small part of the total, the bulk of the poles (over 36,000 in number) being of reinforced concrete, divided among the above named four makes. Load tests already made with these concrete poles have shown a factor of safety of 4.52 in the direction of the pull of the wires and of 3.57 at right angles to the same.

For the cross-arms, wood was used in all cases, partly larch and partly beech. The wood was impregnated with pure oil of tar by the Ruepping process and the cross-arms were reinforced by washer-plates to avoid their splitting. All U-bolts, plates and through-bolts used in supporting them are galvanized, as also the insulator supports. The insulators themselves are of a triple-petticoat type, with a tarred filling or husk between the porcelain and the pin.

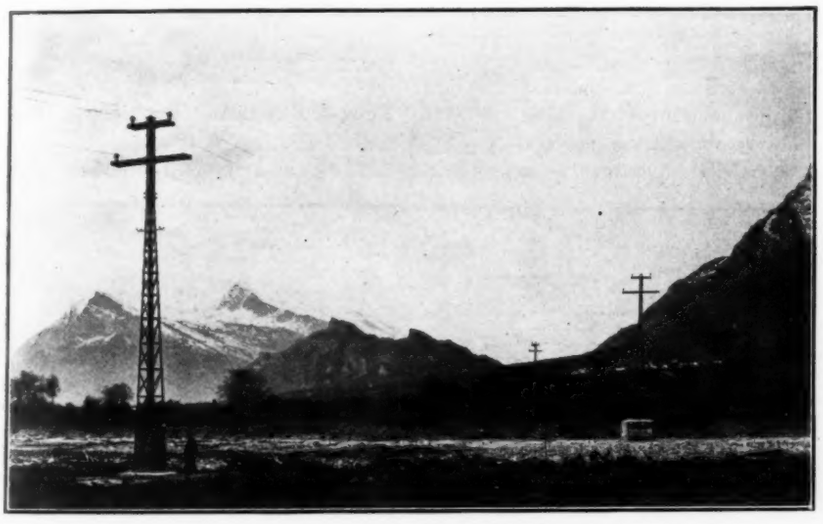


FIG. 3.—A STRETCH OF TRANSMISSION LINE.

A Novel Method of Overcoming Peak-Load Troubles.

Users of electric power are sometimes compelled to buy on a "peak-load" basis, that is, not exceeding a fixed current consumption at any time during the year but paying constantly for that fixed maximum regardless of how much current is used. On this basis of payment, it is evident that continually running close to the specified limit or vice versa keeping the current consumption low at the time of greatest load is advantageous. The former procedure is impossible in many manufacturing processes, as it is in lighting and street railway work; the latter is usually attempted by the use of storage batteries.

Those who have studied this peak-load problem will be interested in a novel solution which has been quite successful in the municipal lighting and waterworks plant of the City of Lachine, Canada, and described in the *Canadian Engineer*. In this instance the low cost and satisfactory operation of a 400-horsepower steam-turbine unit is utilized in effecting the economy. In the Lachine plant, a fourteen-inch two-stage double-suction turbine pump with a capacity of 6,000,000 gallons per twenty-four-hour day is utilized to provide water supply and fire protection for the city, the water pressure being ordinarily eighty pounds per square inch and for fire 120 pounds per square inch.

Current is purchased by the year on a basis which is all right for lighting the city and for pumping at all times of the year except the three winter months during which the lighting load is greatest. It was figured that operating the pump by steam for four or five hours a day during that period could be made less expensive than buying sufficient electric current to operate entirely by electricity. As further advantages of an auxiliary steam installation, the insurance rate on the pumping station could be reduced and the city could be better lighted during fall evenings without incurring unreasonable additional expense.

It was therefore decided to arrange the pump for operation by a 400-horsepower induction motor the greater part of the time but by a steam turbine during the peaks in the lighting load in winter and in case of accident in the electric line.

The installation was furnished by the John McDougall Caledonian Iron Works, Montreal. The pump, of Worthington make, runs at 900 revolutions per minute and is direct connected to an Allis-Chalmers-Bullock motor on one side and a 400-horsepower four-stage Kerr turbine on the other. Either driving unit can be thrown into or out of use instantly by means of clutches on the shaft.

Canadian Power for American City.

Recent dispatches state that the city of Sumas, Wash., has made a ten-year contract with the British Columbia

Electric Railway for furnishing power to Sumas in which city the lighting question is in the hands of a civic body appointed for the purpose. This incident is of interest as it is stated to be the first time that the British Columbia Electric Railway has supplied power without the borders of the Dominion and in view of the international agreement regarding transmission of power across the border.

Homes for Swiss Central-Station Operators.

The question of looking after the welfare of central-station employees, to which so much emphasis was given at the last meeting of the National Electric Light Association, is by no means one that has been felt to confront only the American managers of public utilities. In many sections of Europe steps have already been taken in the same direction and naturally so, as there has always been a strong tendency on the Continent to exercise a sort of semi-paternal supervision over those employed directly or indirectly by either states or municipalities.

A fine instance of this tendency is shown in the homes recently erected by the City of Zurich, in Switzerland, for housing the operators on the Sils-Zurich transmission system, which now supplies current for the street lights of the latter city. In erecting a generating plant on the Albula River, some eighty miles from Zurich, together with four intermediate switching stations, it was found that no suitable quarters would be available for the men located at these plants. The authorities therefore took it upon themselves to provide attractive and sanitary homes at low rental within easy reach of these stations or substations, but far enough removed from the same so as not to be disturbed by the inevitable noises.

For the operators of the turbo-generating plant (a hydroelectric station of 14,000-kilowatts capacity), three houses have been provided, of which the one shown in Fig. 1 is typical. This is a twin building, appropriate both in architecture and in setting to its general surroundings, each tenant having six rooms, besides a bathroom and an attic chamber. The building was designed for easy heating, and besides storage space in the attic, a laundry and cellar in the basement add to the general convenience. Each tenant also has about 2,150 square feet of the garden plot adjoining the house, which enables him to raise his own vegetables and to employ his spare time to good advantage out in the open air. For each of these dwellings the tenant pays a rental of 450 francs a year (about $90) which

FIG. 1.—TWIN HOUSE FOR CENTRAL-STATION OPERATORS.

includes a free supply of water and electric light. Owing to the thoroughness of construction, the cost per half dwelling amounted to about $3,000, hence the rental does not even pay interest on the investment and the difference is added to the operating expenses.

At substations, as at Chur, a different type of building was erected immediately adjoining the station, but also of tasty design and with adequate garden space adjoining the same (see Fig. 2). In this case the building is arranged for three families, each having the luxury of a separate bathroom, but sharing a common laundry. Here the experiment of giving each tenant a separate kitchen (as distinguished from the usual European practice of having a living room with one corner devoted to a kitchen) is being tried as an innovation.

While the erection of these homes for employees solved the housing problem, those stationed at the generating plant on the Albula River were far from any available supply of milk. The management therefore has undertaken to cultivate the adjoining farm land, which had been bought in connection with the hydroelectric installation, so as to supply milk and farm products to its employees at reasonable prices.

The housing system established in connection with the fine transmission system at Zurich sets a new mark for central-station welfare work, at least in Europe. Indeed, the investment required for the workingmen's homes alone has been over $105,000, or a trifle more than the estimated annual payroll of the system.

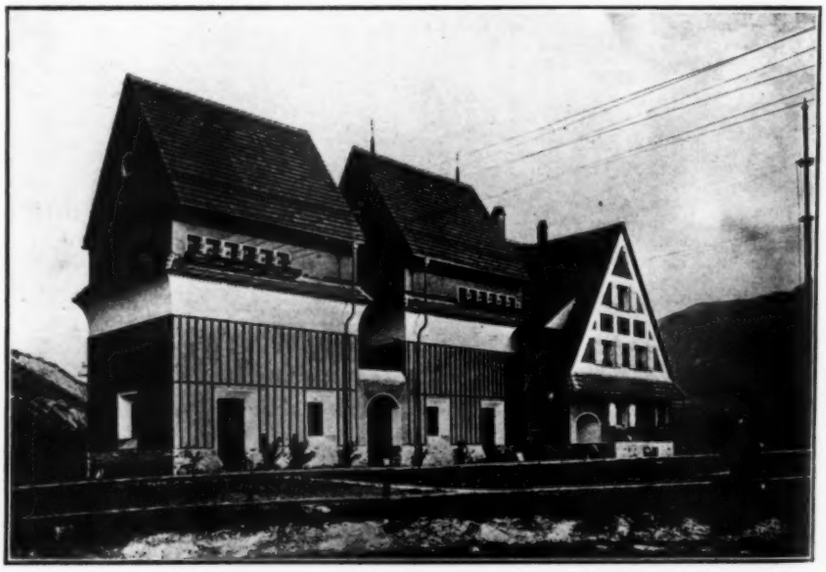


FIG. 2.—EMPLOYEES' HOME ADJOINING SUBSTATION.

Tungsten Lighting Popular in South Africa.

The popularity of the metal-filament lamp progresses in South Africa. Durban street lighting is being improved by the installation of new 400-candlepower metal lamps in place of the old inclosed-arc lamps; for the principal streets flame arcs are proposed, and in the suburbs thirty-two-candlepower Osram metal lamps are to take the place of the present ten-candlepower carbon lamps.

Commercial Practice—Management, Rates, New Business.

ELECTRICITY IN THE HOME.

CENTRAL-STATION EXHIBIT POINTS OUT ADVANTAGES.

According to all reports, the most interesting and by far the most popular exhibit at the recent Canadian Industrial Exhibition, held in Winnipeg, Man., was that maintained by the City Light and Power Department. An ideal home, fitted with every known domestic electrical device, was provided and an efficient corps of attendants was constantly on hand to demonstrate the convenience and adaptability of electricity to the typical dwelling.

Although the electric plant at Winnipeg is a municipal one, the city having recently completed the construction of a new 60,000-horsepower hydroelectric plant, the electrical department, under the management of James G. Rossman, has carried on a commendable campaign for new business commensurate with the most up-to-date privately owned central stations. This is exemplified by the elaborate educational exhibit of the department briefly described herewith.

DINING ROOM DURING ELECTRICAL BANQUET.

VIEW OF LIVING ROOM—"HOME SWEET HOME."

PORTION OF KITCHEN SHOWING A FEW ELECTRICAL UTENSILS.

VIEW IN LAUNDRY—APPLICATION OF ELECTRIC IRON.

"Home, Sweet Home" was the name given the exhibit. The arrangement of the rooms was in accordance with usual practice, the idea of the department being to show the adaptability of electricity to every home rather than to a specially constructed one. The accompanying illustrations show the exhibit from the interior, and views of the kitchen, living room, and dining room.

In the dining room every known convenience has been installed. The dining table is pleasantly illuminated by a soft yellow glow from the dozen odd electrically lighted candelabra revealing a well laid table, with its wealth of silverwear and cut glass. A fan on the sideboard quietly does its part by creating a pleasant breeze, while on the white cloth, within easy reach of the hostess, are the electric chafing dish, toaster, and perculator. The "baby" is here well taken care of by an electrically heated nursing bottle, which may be regulated to any desired temperature.

Just across the hall from the dining room is the den or living room. It is a large, well lighted room, comfortably and cosily furnished in substantial mission style. The room is provided with

an electric fan, electric radiator, vacuum cleaner and electric piano, besides numerous portable reading lamps, etc.

In the kitchen all cooking utensils are electrically heated. In addition there is an electric range, washing machine, utility motor, fan, flat irons, etc. Throughout the entire exhibit the most approved wiring has been installed, with wall and floor switches, sockets conveniently located, etc.

The climax of the exhibit came on July 22, when Mr. and Mrs. Rossman were the hosts of the mayor of Winnipeg and the members of the council at an electrically prepared banquet. The affair was voted an overwhelming success and did much to stimulate the interest in electric cooking.

EXTERIOR OF "HOME SWEET HOME" EXHIBIT.

The following menu was prepared entirely by electricity at very nominal cost:

Punch.

Grape Fruit.
Maraschino.

Bouillon.
French Rolls.

Celery. Radishes. Olives. Onions. Beets.
Salted Almonds.

White Fish. Parsley Sauce.

Milk Fed Chicken.
Creamed Potatoes. Asparagus. French Peas.
Lemon Sherbet.

Combination Salad.

Fruit in Season.
Cake. Ice Cream.

Bon Bons.

Toasted Crackers. Roquefort Cheese.

Coffee.

"Partagas" Cigars. Cigarettes.

Mints.

While enjoying their cigars, lighted by electric cigar lighters, the Mayor and several others spoke of the tremendous advance which has been made during the last few years in the matter of applying electricity in the home for unnumbered little conveniences and of the part that the new city power plant is to play in making many of these conveniences possible in every home by supplying the best of power and light at the lowest possible cost.

Lighting Rates in Baltimore Reduced.

The Consolidated Gas & Electric Light Company of Baltimore, Md., has, since the advent of hydroelectric power from the McCall Ferry plant, voluntarily reduced the cost of street lighting for the City of Baltimore.

The new rate for arc lights will be $74 a year, which is $1 less than the present rate. This rate will prevail in the subway district. Where the current is supplied by overhead wires the cost will be only $60 a year, which is twenty-five cents cheaper than last year.

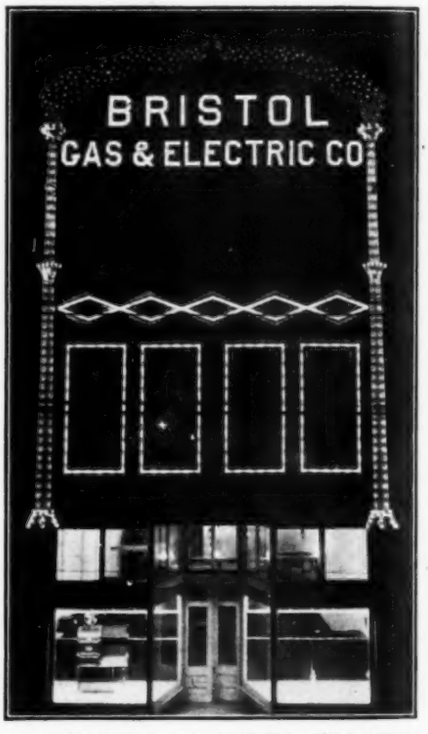
The greatest reduction, however, is in the cost of the forty-candlepower incandescent lights, the reduction being from $23.50 to $20 per lamp. The rate given for the sixty-candlepower incandescent light is fifty cents less this year that it was for the forty-candlepower light last year.

The saving will be considerable, for there are 12,600 arc lights in use and about 600 incandescent lights.

New Building of Bristol Gas & Electric Company.

The accompanying illustration shows the new office building of the Bristol Gas & Electric Company, Bristol, Tenn., as it appeared the opening night, on which occasion the general public was invited to inspect the company's handsome new quarters.

The spectacular electric sign, extending from the sidewalk to thirty feet above the top of the building was turned on for the first time and was a revelation to those who saw it. It is a new design and contains 2,000 incandescent lamps. The shunting effect of the flames leaping from stately columns on either side and uniting at the center above the building presented a most beautiful spectacle. The lamps are red, green and white. The four large windows in the second story are each inclosed by separate outlines of white lamps while above them and extending across the building is artistic zig zag with a chasing effect that attracts the eye.



ILLUMINATION OF BRISTOL COMPANY'S NEW BUILDING.

The officials and their wives received the visitors and during the evening there was on display a full line of gas and electric appliances, all connected and in working order. These were demonstrated to the visitors.

In April, 1910, when the Doherty Op-

erating Company took over the Bristol Gas & Electric Company electric signs were practically unknown in Bristol and midnight window lighting was unheard of. Now there are fifty-two large and handsome electric signs in the city while the windows of practically all of the business houses are lighted until midnight. State Street was formerly lighted after dark only by the city lights but now it is brilliantly illuminated until 12 o'clock every night as a result of the progressive work of the company under the Doherty ownership. What is true of State Street is true of other streets in the business section of the city.

July 4, 1910, the Doherty company presented to Bristol the monster electric slogan sign burning 1,000 lamps. This served to increase the popularity of electric advertising. In September the company installed the mammoth "Cook with Gas" sign on the Dooley-Bayless Building. Now it has installed an electric sign upon its office that eclipses anything in Bristol.

Immediately after taking over the local company the Doherty company put into effect its nation-wide policy of getting close to the people. It has joined heartily in every movement for the improvement and betterment of Bristol. It has sought to get closely acquainted with its consumers and has accomplished this purpose. It has pursued the policy of making itself understood to the public.

The company is now permanently located in quarters that are superior to those of any lighting company in the south, and expects to be more able than ever to serve its customers, extend its business and continue in the movement for a greater Bristol and incidentally a "brighter" Bristol.

The feeling in Bristol, as abundantly evidenced at the brilliant opening of the new quarters recently, is that Bristol is fortunate in having its lighting company operated by such progressive and able interests as the Doherty company.

Business Value of Ornamental Street Lighting.

It has been said that the value of property on a business street is directly proportionate to the number of people who make use of the street as a thoroughfare. The writer had his attention most forcibly called to this potent fact while negotiating with a real estate man for the rental of a store on the principal business street of a large Canadian city.

There were two vacant stores directly opposite. The difference in rental asked was over fifty per cent. It was explained that a greater number of people promenaded on one side of this street than on the other. Naturally the most expensive location was immediately leased. The question arises, "Why did the people choose to use one side of this thoroughfare to a greater extent than the other?" The reason was obvious; there was far more light on the busy side.

An enterprising merchant realizing that the crowd will seek the light canvassed his fellow tradesmen towards the installation of a greater number of lamps for his particular block.

It followed, of course, that a far greater number of popular retail stores located on the side upon which the above-mentioned merchant's store was located. The competitors across the street stated that "their customers never came down town at night; that they had all the trade they wanted, and that the city should light its own streets, etc.," forgetting that they would benefit to a greater extent than the people in the residence districts so far as increased profits were concerned.

However, the "advanced side" men formed an association, secured informaeion upon the cost of installation, current, etc., and purchased collectively a number of ornamental iron lamp posts, each post supporting four arms holding 100-watt tungsten lamps. The people crowded the "advanced side" nightly. "Let's run down town to see the windows on Bright street" (for the merchants with the assistance of the illuninating engineer connected with the local electric light company scientifically illuninated the windows), was an oft repeated suggestion. During the day, naturally, buyers would seek the "advanced side" on which were the stores where the goods viewed the previous night were displayed. Sales rapidly increased and the additional profit more than paid for the cost of installation in a very short time. Later the "blind side" men came to their senses and in a short time the entire business district was brilliantly illuminated with many lamps supported by ornamental iron standards.

The new-business manager of a western city decided to properly illuminate the business district of the town. Single arc lamps were in use, but they merely accentuated the gloom. To convince the merchants of the value of a brilliantly illuminated thoroughfare he counted the number of people passing a given point in a neighboring city when the streets were properly illuminated.

The figures he secured were startling. With an equal population and the people engaged in practically the same industries, he found that three times the number of pedestrians passed the point than in the less brilliantly illuminated city. Today this manager points with pride to one of the brightest thoroughfares in the country.

The revenue derived from this class of business by the electric light companies is more than satisfactory. The business men's association co-operate gladly, and wherever the central station has furthered this system of illumination their relations with the public have become most cordial.

Expense of Establishing a Public Utility.

William J. Hagenah, one of the experts of the Wisconsin Railroad Commission, who until recently was retained by the City of Chicago to investigate the gas situation with a view to recommending a lower gas rate, in an article written for the *Voter*, explains a number of utility problems.

The expert declares that history shows that a great many public-utility companies do not begin to pay for years after their establishment, and that while a company may at the present time be apparently earning a considerable amount, yet it actually is not what would be termed a well-paying property, because of the great losses sustained in establishing the business. In this connection he said:

"A public-service corporation is entitled both by common law and by statute to a reasonable return upon its investment. If a given rate schedule yields more than a reasonable return to the investor it is an injustice to the public, and the rates should be lowered. If the rates fail to produce sufficient revenue, the investor is not receiving that return to which he is entitled by law. If he has received a reasonable return each year on his investment from the beginning of the enterprise, justice would seem to be satisfied, at least as against the public, without allowing any increase in the value of the property which produced that income to represent going value. If the investor has failed to receive each year that amount

which constitutes a reasonable return, he should be permitted to charge rates sufficiently high to reimburse him for early losses, or such losses should be considered as costs of developing the business, and their addition to the value of the physical property permitted. Such additions, from an equitable standpoint, at least, may be said to constitute the correct going value of a public-service corporation.

"New plants seldom yield a return on the investment during the first year of operation. In fact, it is more likely to require a number of years of continuous effort to establish a business on a firm basis. The history of public utilities clearly shows that many of such plants have not reached a position of profit to the investor until many years after their construction. During the earlier years a large amount of money is required for development purposes. Where a corporation is in possession of adequate capital, expenditures of this character can be made without serious loss to the stockholders; but where, as is almost universally the case, the business is developed out of the earnings at the expense of interest and dividend payments, a deficit will result. When a corporation is earning less than its operating expenses, interest and depreciation, it is absolutely necessary that the stockholders make further payments for development purposes. Where a small surplus is earned, such amount may be used for development purposes, but it is at the expense of the stockholders' right unless such development requirements are recognized in the capital. If the development cost is not met out of the earnings, it must be met directly by the sale of securities, which becomes a liability against the plant.

"The amount by which the earnings fail to meet the operating expenses and the return on the investment creates deficits which constitute the cost of building up the business. Just as supervision, interest and insurance during construction are expenditures to be added to the construction cost of the plant, so the deficits representing the amounts by which the stockholders have failed to receive their reasonable return are costs to be added to the value of the physical plant in order to show the complete investment which has been made in the industry as a live, going concern. The investor has a right to expect reimbursement for such losses. They are legitimate costs of business."

House-Lighting Campaign at Rockford, Ill.

The central station at Rockford, Ill., is conducting a campaign to increase residence-lighting business with good results. The company has put in force a flat-rate charge for house lighting which has been favorably received.

The flat rate charge is based upon the use of tungsten lamps. Under the new rate the customer can install as many tungsten lamps in his house as he pleases, and contract to use a minimum of four at any one time, or more if he desires.

The net rate made for this service is $1.00 per month for four twenty-candle-power tungsten lamps. In the event of the customer requiring the use of more lamps than the minimum number of four, an additional net charge of twenty-five cents per lamp is made for all additional lamps which he may desire to use at once.

It must be noted that no regard is taken of the number of lamps actually installed, as only the lamps needed for simultaneous use are charged for.

In order to establish a basis of agreement and to prevent the abuse of the flat-rate privilege an excess indicator is installed in place of the ordinary meter. The only penalty attached to an abuse of the flat rate is that in the event of more lamps being lighted or larger lamps used than are under contract, all the lamps so lighted will flash, thus giving notice to the customer that he has too many lamps lighted at once.

In order to prepare the way of this flat rate the Rockford Electric Company has arranged with the electric contractors of Rockford to wire all of their houses for them at cost. The price for wiring a six-room house complete with standard fixtures is but $27.45.

Many progressive householders will take advantage of this offer, and it is believed that there will be many later applicants who cannot be attended to promptly, so it is urged that application for service should be made without delay.

The company has secured five expert illuminating engineers to visit prospective customers and explain any points in the plan not thoroughly understood and to lay out the lighting arrangements in the most up-to-date and comprehensive manner. These men will call at any hour of the day or evening most convenient to the customer upon notice to the light company.

Telephone Rates in Los Angeles.

As a result of numerous protests from citizens filed with it, the City Council of Los Angeles, Cal., has changed the proposed increase in telephone rates, recommended by the former Board of Public Utilities and K. B. Miller, telephone expert retained by that body.

The rates decided upon by the Council are practically identical with those in force for the past year. They are given per month for both the Bell and independent systems as follows:

Class of Service	Sunset (Bell System)	Home (Automatic)
Business Telephones—		
One party	$5.00	$5.00
Two party	4.00	3.50
Four party	3.00	3.00
Residence Telephones—		
One party	3.00	2.00
Two party	2.25	1.75
Four party	1.50	1.50
Private Exchanges—		
First Trunk Line	8.00	6.00
Each additional line	6.00	5.00
Business Telephone—		
One party, limited to 100 calls	5.00	4.00

Electric Light Company Shows the Way.

On July 21 the Geneseo Electric Light Company turned the current on their mammoth electric sign in front of their office building at Geneseo, Ill. Other business men of this enterprising city were quick to follow the example of the electric company and a dozen signs have been ordered.

Brooklyn Edison Company Makes Wiring Proposal to Contractors.

The Edison Electric Illuminating Company has made a proposal to contractors, extending from July 15 for two months, whereby it agrees to give a wiring job, secured by its new installation bureau on a house already built, to any Brooklyn electrical contractor who secures for himself the wiring of a house already built and along the line of the company's mains. That is to say, every time a contractor independently secures such a job the Edison company awards him a similar job secured by its own staff.

The offer is stated to be in the nature of an experiment, but if the results are satisfactory it will be continued beyond the present time limit.

Ontario Lighting Rates Reduced.

At a recent meeting of the City Council of Ontario, Cal., that body authorized the city attorney to draw an ordinance lowering the primary rate for electric lighting from 13 to 11 cents per kilowatt-hour, with ten per cent discount for prompt payment.

Electric Lighting and Illuminating Engineering

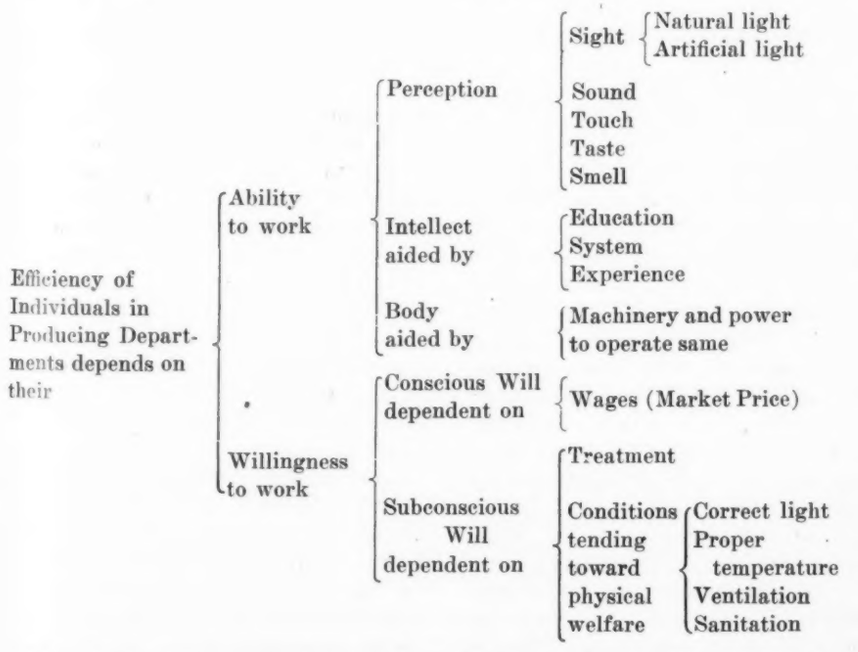
IMPORTANT CONSIDERATIONS IN FACTORY LIGHTING.

BY F. B. ALLEN.

It may be stated that the success of any industrial institution depends upon the efficiency of the individuals in that institution. This is evident, as all work planned or produced is the result of human thought.

Every industrial institution has four departments, the finance, executive, producing and sales departments. Each one of these departments is of equal importance, yet the greatest money value is represented in the producing department. Thus, a highly efficient sales department may be employed at less price than a producing department. It is therefore of extreme importance that the individuals in this department work at highest efficiency. Any considerations tending toward the production of this efficiency should be of paramount interest.

Below is a diagram of the relations of shop conditions to producing-department efficiency:



This shows that an employe's efficiency depends upon two things, ability and willingness to do the work. As far as ability is concerned, it is dependent upon three considerations: first, powers of perception, of which in nearly every case sight is of the greatest importance; secondly, brain, or intellect, to direct; and lastly, body to perform the work. Willingness to labor depends upon conscious and subconscious will. Consciously, wages are largely influential in producing the will to work; subconsciously, the realization of fair treatment by employers, and conditions in the factory tending toward health, such as correct illumination, proper temperature, good ventilation, sanitation, etc.

It will be noticed that in both divisions, ability and willingness, light is a strong consideration. If a man cannot perceive or see, he cannot properly plan or execute. Again, if the illumination is such as to strain his eyes, producing mental fatigue and nervousness, he will unconsciously be unwilling to work. The thorough consideration, therefore, of the qualities of illumination which will produce the desired results toward ability and willingness are of interest.

There are four qualities in illumination which should be considered: first, the correct amount of light, that is, the happy medium between dimness and dazzling brilliancy; second, the lack of glare of high intrinsic brilliancy; third, the lack of flickering; and lastly, the elimination of harmful radiations.

Under the correct amount of light we may say that the eye is able to work under a broad range of intensities. Thus, we can often read accurately in moonlight and still can do so in dazzling sunlght, the latter being over a million times the brilliancy of the former. However, it may be stated that, dependent upon the class of work, the eye should be exercised under from one-half foot-candle to fifteen foot-candles in artificial illumination.

Glare is an extremely harmful characteristic in any illumination. It not only cuts down the ability of the eye to see accurately, but produces eye-strain and nervousness.

Flickering is also an extremely deleterious quality. Its results are about the same as are produced by glare; inefficiency of the eye in working, together with eye-strain, due to the rapidity with which the eye tries to re-focus under the different intensities. This quality may be brought about in either one of two ways. Either the light source varies in intensity or the light upon a given plane of working is not even. In either case the eye must re-focus very often.

The absence of glare and the uniformity of illumination produced by mercury-vapor lamps are well shown by the accompanying illustrations of typically good shop lighting.

The most effective rays in producing vision are the yellow and green. The fact that these are the principal rays in the spectrum of the mercury-vapor lamp accounts largely for its very high illuminating efficiency. The rays on either side of these in the natural spectrum are of less practical value, since they require to be much more powerful in order to produce the sense of vision, and hence strain and fatigue the eye to a correspondingly greater extent. The red and heat rays are particularly irritating for this reason. The differ-

ent colors also produce well known mental effects. Thus, red is exciting, while blue and violet are depressing. The use of a red flag in bull fights and the well known expression "feeling blue" are recognitions of this fact. Yellow gives contentment, while green is restful.

The mercury-vapor lamp has qualifications which are extremely advantageous to industrial illumination. It is a scientific fact that the eye will focus more accurately under the green rays produced by this lamp than under a combination of the seven colors of the spectrum. For this reason it is extremely advantageous to employ this light where accurate eye work is required. It is evident for the same reason that the eye can see more distinctly under lower intensity of illumination with green light than with a combination of the seven colors of the spectrum.

The light produced by the mercury-vapor lamp is extremely low in intrinsic brilliancy, the amount of light being produced rather from the area than from the brilliancy of the source. This results in a total absence of glare, not only where the source is directly exposed to the eye, but from polished surfaces. This reflection of glare from polished surfaces is found to be extremely annoying and of as serious a character as the exposing of the direct rays of the lamp.

Where mercury-vapor lamps are employed, the system is of an overhead character. The lamps are placed so to light a certain number of square feet and are laid out symmetrically, regardless of the placing of the work beneath. This produces a perfectly evenly distributed light on the floor. It may be seen, therefore, that upon a working surface no different intensities of illumination will be found, and, therefore, the eye will not be called upon to refocus. The source, which is the tube varying in length with the different types of lamps, is a steady line of light, being in any given period of exactly the same intensity. The length of the source is a very decided advantage, tending towards distribution and the elimination of distinct shadows.

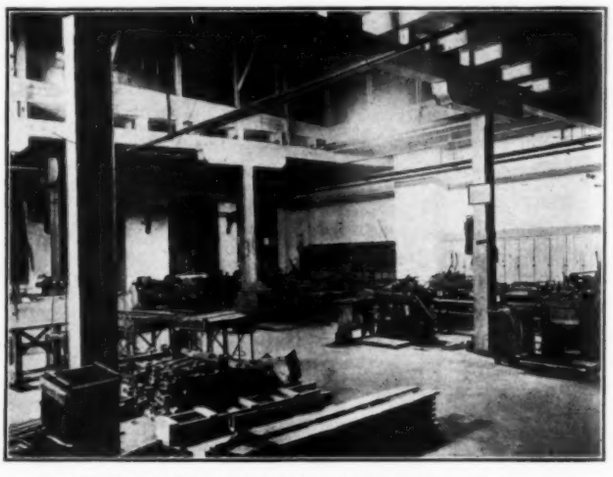
An analysis of the qualities of the mercury-vapor lamp will show that where color values are of little importance, the other qualities of the light are exactly those which are required to produce correct illumination for employees in industrial work. The importance of this cannot and must not be overlooked. For instance, in one of the large silk mills of the East, it is figured by a well known cost expert that the expense of producing their product at night is twenty per cent higher than that of producing it in the daytime. This may have been due to several things, but must be largely attributed to inferior illumination. Had these people in their factory had an illumination during the dark hours which was as good for working purposes as the best daylight, their cost of production during that time would very evidently have been largely decreased.

It seems strange that the importance of this consideration has been overlooked, particularly in view of the fact of the extremely low comparative cost of units of illumination and of their operation.

A large modern factory, it may be figured, can produce power at a cost of one cent per kilowatt-hour. A mercury-vapor lamp can be run five hours at a power expenditure of one kilowatt-hour. On an average in industrial lighting one mercury-vapor lamp will take care of at least two men. Figure an average cost of forty cents per hour to employ these two men. This would mean an expense of $2 to employ these two men five hours, whereas perfect light for them can be produced for one cent. In other words, if perfect light will save one-half of one per cent of a man's time, it has paid for its total cost of operation.

Not only that, but the value of machinery and factory investment is increased in proportion as the efficiency of the men is increased. Thus, with improved illumination it is not difficult to imagine that twenty machines will do the work that twenty-five had done heretofore. The value of the given investment has increased twenty per cent, or probably ten times the value of the lighting units to produce this result. These are extremely important considerations in any industrial lighting installation, and cannot be overlooked. Any system of figuring which does not consider these points is entirely fallacious.

As far as actual operating cost goes, however, it may be said that the mercury-arc lamp is one of the most efficient units at present in the illumination market. Further, its cost of upkeep is extremely low, both as to attention and repair parts required to operate, and as to the actual renewal expense of the tubes.



TWO VIEWS OF WELL LIGHTED SHOPS. ABSENCE OF GLARE IS PARTICULARLY CONSPICUOUS.

Telephony · Telegraphy and Wireless

THE DISTRIBUTION SYSTEM OF A TELEPHONE PLANT.[1]

BY H. B. STABLER.

The intent of this paper is to give a general idea of some of the problems encountered, the methods of handling them, and the solutions obtained in connection with the design and construction of conduit, cable, pole and wire lines for telephone distribution; and to call attention to some very important differences between these engineering problems in telephone distribution and those met in the distribution of such other public-utility service as electricity for light, heat and power purposes, gas and water.

While there is a great amount of analogy between the distribution to customers of electrical energy, gas, or water, and the distribution of telephone service, there are also dissimilarities of the greatest importance. In the case of electric light and power, gas, or water service, the supplier generates, manufactures, or collects a commodity which is conveyed in bulk, as it were, to the localities of the consumers, and distributed and sold to them in retail amounts. No particular gallon of water, cubic foot of gas, or watt-hour of electrical energy need be delivered to any particular person. If each person gets his full measure of a product of proper purity or illuminating power, delivered at proper pressure, he is satisfied. The supplier can deliver his goods through a single or a few large mains or conductors, which ramify in every direction and diminish in size as they serve their thousands of customers.

Telephone service, on the other hand, is not a commodity furnished to the consumer in the same sense as has been used above. It cannot be manufactured at a central station and furnished through a single large pipe or conductor to thousands of consumers. Telephone service, as furnished to a community or an individual, is a complete means of communication with all other patrons of the service. By faithfully furnishing adequate means of communication, the supplier of telephone service fulfills his duty. The thoughts and ideas which are communicated originate with the patron, and are transmitted to the particular other desired patron, and although they pass through the supplier's central office they are at no time his property, and further, they cannot be transported in bulk, but must at all stages of the process be kept absolutely separate from all other communications. Each conversation between two subscribers, in the same or different exchanges, requires, then, that for the time being a separate pair of conductors shall be maintained, connecting the one with the other. And this, in turn, requires that each subscriber (or in the case of party lines, each small group of associated subscribers) shall, at all times, have his separate and distinct pair of conductors connecting him with the central office.

It is of interest to note that while one of the largest electric lighting and power substations in Washington uses copper conductors of a very large aggregate cross section, in order to supply the energy for a large section of the city for arc and incandescent commercial and street lighting, and other power and miscellaneous purposes, the output reaching at times the high figure of 22,400 amperes and 6,600 kilowatts, the total number of conductors which conveys this energy away from the substation busbars is only 128; while in the case of Washington's "Main" telephone central office, though the aggregate cross section of the distributing conductors is very much less, and the current conveyed by them is relatively very insignificant, the number of conductors reaches the large total of 32,800.

Another important consideration, to which attention has often been called, is the following: In most of its public utilities, such as water, gas, electric light, street car, fire alarm service, etc., each community is self-contained and substantially independent of all others; thus, the Consolidated Gas, Electric Light & Power Company in Baltimore, for instance, constructs and operates its lighting plant, including the determination of the proper frequency, phase and voltage for its transmitting and distributing lines, the design or selection of its engines, generators, transformers, rotaries, lightning arresters, etc., with the utmost regard for a great number of local and manufacturing conditions, but with absolute indifference to the corresponding practices of its neighbors, the Philadelphia Electric and the Potomac Electric Power companies. There is no occasion for uniformity of practice, as there is no connection or interchange of products between the several systems. But in a comprehensive telephone system, while general manufacturing conditions, and multitudes of local factors in each community, must receive the same careful consideration as with the lighting system, it is also essential that the practices in the design and operation of the plant must be in a very large measure uniform in all of the communities of the system. In order that telephone subscribers in Washington may satisfactorily communicate with subscribers at other points, the telephone plant here must be designed and operated harmoniously with the plant in Baltimore, Philadelphia, New York, Boston, Chicago, New Orleans, Omaha, etc.

GENERAL INVESTIGATIONS.

Telephone plant may be mainly divided into three principal classifications: central-office plant, including the land, central-office buildings and their contents; distributing plant, consisting of lines of conduits, cables, poles, and wires which radiate from each central office and connect with the numerous subscribers and with other central offices; and subscribers' equipment, consisting of the telephone instruments with their associated auxiliary apparatus and service wires. Our theme is the distributing plant, but before we enter into a discussion of the details of such plant it will be appropriate to speak for a few minutes of the broad preliminary investigations and studies which are made, and upon which are based all specific plans for the construction of both distributing and central-office plant. I refer to the so-called "development study" and

[1] Abstract of a paper presented before the Washington and Baltimore Sections of the American Institute of Electrical Engineers.

"fundamental plan," which are made in the order mentioned, the latter being based on the former. The development study determines primarily the expected number and class of subscribers in each block or small group of blocks in the city at some future time, usually about twenty years ahead; the fundamental plan shows essentially the number and locations of the central offices which will be most economical to serve these subscribers and the general scheme, as regards locations and number of ducts, of the underground conduit system which must be provided.

DEVELOPMENT STUDY.

In making the development study, exceedingly painstaking efforts are made to arrive at the most accurate possible forecast of the number, class and locations of the future subscribers. The business management of the company generally undertakes this part of the work, but by whomsoever it is handled, all available sources of information are consulted, including census reports, city records, real-estate operators, transportation companies who may by the extension of their service promote the building up of certain sections, etc. Each city block is considered, a count is made of the number of buildings of each class which it contains, and of the number and size of the unimproved building lots. For blocks which have not been subdivided into lots and regions that have not been laid off into blocks, after careful study, forecast is made of the future probable number and size of the building lots, and the number and character of the improvements which they will contain, and from this is deduced the expected number of direct line, party line, and private-branch-exchange telephone subscribers.

FUNDAMENTAL PLAN.

Upon the chief engineer usually devolves the important and laborious work of making the fundamental plan. From the estimated numbers of the several classes of subscribers, he readily obtains the total number of lines, and with this known, and a decision reached as to how many of the lines may consist of 22-gauge cable conductors, and how many, on account of their length, require 19-gauge conductors, the number of 600-pair and 400-pair 22-gauge, and of 300-pair 19-gauge cables, and therefore the number of ducts is calculated, making due allowance for the fact that there is necessarily, at all times, a certain percentage of idle conductors in each cable.

Of course, it is not to be inferred that an absolutely accurate determination can by any process of study be made of the number of telephone subscribers twenty years, or even five years ahead, but a fairly good prophecy can usually be made, and by continually revising the study, so as always to be anticipating a long way ahead, very large savings will result as compared with the alternative method used in earlier times, of glancing over the map and deciding, "I guess we will locate our central office at the point 'A,' and we will lay eight ducts on X Street, and six on Y Street and four on Z Street, and if it turns out to be too few, we can dig up the streets again and lay some more."

The locations of the subscribers are obviously not in the least subject to the telephone company's control, but wherever the would-be patron establishes himself, there must the company's service be made to reach him, be he easy or difficult of access. The location of the central office, on the other hand, is a matter subject to the company's discretion, and, as heretofore mentioned, its determination is one of the important points in the preparation of the fundamental plan. I cannot attempt here any detailed description of the exhaustive treatment which is given to this interesting problem, but suffice it to say that the study is an extremely complex one, involving both the present number and locations of the subscribers served, and the probable number and locations at the quite distant future time selected for the study; the present and future average number of calls per day to originate at each telephone; the proportions of direct line, party line, public telephone and private-branch-exchange telephones; the amount of toll and long-distance service; the grade of transmission which is to obtain in the system; the price of real estate, and the locations of available building lots; proximity to the street or streets best suited for the construction of the main distributing leads; the rates of compensation which the company will receive for the service which it renders; in short, a host of factors too numerous to mention, all interrelated and interdependent.

Assuming the locations of our central offices to have been properly determined, we will pass on to a very brief general consideration of the system of subways or underground conduits. But, of course, it will be understood that these two subjects cannot be treated independently of each other. The fundamental plan determines for a period of about twenty years ahead not only the probable number of central offices in the community in question and their locations, but also the boundaries of the area which each office will serve, the number of subscribers and trunk lines terminating in each, the lines of conduits extending from them in all directions to serve the numerous subscribers and to connect with the neighboring central offices, and the number of ducts required at each point of each conduit line, including the reservations, if any, which must be made for toll and long-distance cables.

In placing underground conduits, a large proportion of the expense is due to opening and restoring the street, and therefore it is obviously specially desirable to take thought for the morrow; and by comparing the cost of laying additional ducts now, and carrying interest, tax, maintenance and depreciation charges on them while they are idle, with the cost of reopening the street later on to place additional ducts, it has been decided, considering the likelihood of changes in the art and the general uncertainties of the future, that about twenty years is probably the most economical period for which to anticipate future needs.

I have touched upon some of the general aspects of telephone engineering, and endeavored to give you an idea of the great complexity and difficulty of solution of the problems which the telephone engineer must face. Those who care to read a fuller and very lucid discourse on this subject are referred to a classic paper by J. J. Carty, chief engineer of the American Telephone & Telegraph Company, which will be found in the *Transactions* of the American Institute of Electrical Engineers for 1906. I will now discuss the subject of telephone distribution more explicitly for a few minutes and will deal to some extent with engineering problems which, being more detailed and local in their nature, are handled by our local engineering corps in Washington. The local conditions, problems and practices which obtain in this city are, however, in a general way typical.

From several important standpoints, the ideal telephone distribution system for a city would contain exclusively underground cables and wires. The ideal condition may obtain in the business section, or wherever are found individual buildings containing considerable numbers of telephones, as in such cases it is usually practicable to carry branches of the underground conduit and cable system directly into such buildings. The next nearest approach to this condition is where the number of telephones per city block is sufficient to justify the carrying of a branch conduit and cable into the interior of the block for the purpose of serving that block exclusively. When this very desirable method cannot be employed because the telephone density, or the number of telephones per block, is not sufficient to justify the large expenditure which it requires, recourse must be had to alley pole lines extending from block to block, or, if the system of alleys in the blocks in question will not permit of this, to street pole lines; these poles lines carrying aerial cables or only wires on cross-arms, as the circumstances may determine. Distribution from street poles is also sometimes necessary where the telephone development is sufficient to justify the method of distribution from within the interior of the block, but where public alleys are not available, and the property owners have not yet come around to the point of granting to the company the necessary right-of-way privileges.

CONDUITS.

Having decided upon what streets to build our conduit lines and how many ducts to lay, and having obtained the necessary municipal permits, and purchased the material, the trench is opened, and if terra-cotta duct is to be used, a four-inch layer or "base" of concrete is usually first placed; single terra-cotta duct with a 3.25-inch circular bore in sections eighteen inches long may be laid upon this base, or four-way or six-way multiple duct in thirty-six-inch lengths may be used. In cases where the concrete base may be omitted, it is sometimes economical to use creosoted wood ducts. A 1.5-inch creosoted plank is laid on top of the ducts as a protection from injury when subsequent excavating is done in proximity to them. The trench is usually of such depth as to bring the top of the protecting plank at least eighteen inches below the street surface.

Manholes are of varying sizes, depending largely on the number and size of the cables which must pass through them. In Washington they are usually made of brick, with either reinforced-concrete or I-beam-and-brick roofs, but in some localities they are of the concrete-slab or the monolithic-concrete type. As far as possible, manholes are drained by permanent connections to adjacent sewers. Their locations are usually at street intersections or at street and alley intersections, but intermediate manholes may be required in order that the spacing shall not exceed 500 to 550 feet, or for the purpose of taking out branch cables for local distribution.

CABLES.

We next come to the consideration of cables. We have seen that where the telephones are few and far between they are reached by pole lines carrying open wires. As the number of telephones increases, the open wires on the main pole line are replaced by aerial cables, so that the one line of poles may readily carry 50, 100 or several hundred pairs of wires.

As the increase in the number of subscribers goes on, the time comes when the pole lines and aerial cables give way respectively to underground conduits and cables. There is always to be expected a steady growth in the number of circuits which must be provided between the central office and the various parts of the areas served by that central office. Even if the time shall come when every office in the city has a telephone on each desk, and every residence has service in each room, the number of necessary circuits will still continue to increase, since the growth in offices and residences in the city is bound to continue.

Standard telephone cables are made which contain varying numbers of pairs of wires from 1 up to 600. In Washington the sizes in most frequent use are those containing 10, 15, 25, 50, 100, 200, 300, 400 and 600 pairs, respectively, but sometimes smaller and intermediate sizes are used. As one would suppose, the price per foot charged by the manufacturer increases as the number of pairs in the cable increases, but in a lessening ratio, so that for one pair of conductors the price per foot grows steadily less as the size of the cable increases. When the cable has been installed for distribution purposes in a conduit, on a pole line, or in a building, as the cost of installing, splicing, etc., does not increase in the same proportion as the size, the decrease in the unit cost per pair for the larger sizes of cables becomes more and more pronounced. Especially does this apply in the case of underground cables when the proportionate part of the cost of duct and manholes is added to the unit cost of the cable pair.

It is evident then, that it is particularly desirable always to install a cable containing many more pairs than are immediately needed, but it would be going to an extreme to install a very large cable now at a cost of $1 per foot, part of whose conductors would remain idle for twelve or 15 years, when a small cable costing from twenty to thirty cents per foot would be adequate for from three to five years. In determining the most economical size of cable to place on a particular job, or which of several possible jobs to do—whether to place underground conduit and cable, or poles and aerial cable, for instance—the first cost is not, of course, the sole determining factor, but a study is made in which the annual charges of the several methods are compared, and that method is selected for which the annual charges are the lowest.

The principal factors that go to make up these annual charges are four: the interest on the money invested; the taxes; the maintenance, or the money which must be expended each year to keep the plant in serviceable and proper condition; and the depreciation, or the money that must be set aside each year to replace the plant with new plant when, through gradual decay or obsolescence, it has become unfit or inadequate for further service. One of the most frequent cases to be studied in this way is the proposed replacement of a present pole line carrying aerial cables by a line of underground conduit and cable. In such cases, the annual charges on the proposed underground plant are figured, and it will be found that there will be a large expenditure in interest; with the present aerial plant, the interest charge is much less, but, on the other hand, the maintenance and depreciation charges are far greater; by making a comparison of the annual charges for, say, the next five years, of the underground versus the aerial plant, and taking into account the so-called "transfer loss," if the present aerial plant, which still has, say, five years of wear in it, is to

be removed from service now, the job which is the most economical in the long run is determined upon.

Some of the very first attempts to lay underground telephone wires were, as we look back upon them now, quite ludicrous. In Washington one plan that was tried, at heavy expense and with no success, was the placing of bare copper wires in a wood trough in a trench in the street, the wires being held in position and separated from each other by being drawn taut through holes in porcelain plates fixed in the trough; the trough was then poured full of tar, covered with a plank, and the trench filled. Washington's balmy summer climate, however, proved to be a little too much for this system; a gentle slope in the street caused the tar to flow toward the lower end of the conduit, where it leaked out of the containing trough and oozed up between the paving blocks to the street surface. This allowed the wires to cross with each other, making the experiment a failure.

Then rubber-insulated cables, similar to successful telegraph cables, were tried and used to a limited extent for very short distances. As a less costly and more efficient substitute, cotton-insulated wires were formed into a cable, impregnated with paraffin, and covered with a lead sheath; but the same phenomenon that seemed for a while to be an insurmountable obstacle in the way of trans-Atlantic telegraphy made speech difficult through a short length and impossible through a considerable length of one of these cables. The electrostatic capacity of a mile or so of the wire in such a cable, although not noticeable with the comparatively large, slowly interrupted currents used in telegraphy, was absolutely fatal to the transmission of speech, which depends upon the most minute alternating currents, of very high frequency and very complex wave-form. If the little voice-current was not completely absorbed by the capacity of the conductor, it had its wave-form so changed that it could not reproduce intelligible speech at the further end of the line. The preservation of the wave-form is the important thing. It has been frequently pointed out that with the transmission of power over long-distance by means of alternating currents, the thing sought is to get the largest possible percentage of the developed energy delivered safely at the farther end of the line, while the telephone transmission energy loss is of small importance compared with distortion of the wave-shape. The man who works on the problem of long-distance telephone transmission is probably not at all horrified by the idea of energy losses in the line of ninety-five or ninety-nine per cent, provided he can prevent material change in the shape of the wave.

After the early attempts with rubber-insulated and paraffin-core cotton-insulated telephone cables, the dry-core paper-insulated cable was developed, and there is now more than 7,000,000 miles of wire in use in such cables in the plant of the associated Bell telephone companies.

By means of a wire drawn in while the duct is being laid, or by means of sectional rods pushed through the ducts from one manhole to the next, a hemp or wire rope is drawn through the duct by means of which the cable is in turn dragged into place. In some localities the rat-and-ferret method is or has been in practical use. This consists in sending a rat through the duct, followed by a ferret in harness, who, in his pursuit of his intended prey, draws a light cord through to the next manhole, by means of which a heavier cord or rope, and finally the telephone cable is drawn in.

The splicing of the cable, to make a long story very short, consists essentially in removing the lead sheath from, say, eighteen inches of the ends, boiling the paper-insulated conductors in melted paraffin, so as to prevent both the absorption of moisture by the exposed ends and the passing of moisture back under the lead sheath; the splicing of the bared conductor ends together by means of tightly twisted joints, which are reinsulated by slipping over them tubes or sleeving of paper or cotton; and, after another boiling in paraffin, the inclosing of the entire splice in a lead sleeve which, though much larger than the cable sheath, is thoroughly sealed to it by means of carefully wiped joints.

The testing out and splicing of a large cable which divides up into numerous branches, having a total of, say, fifty terminals, and each pair brought out at several different terminals, is quite a complicated job, requiring that many test splices be made.

The necessity for the multiplying or duplicating of the cable pairs in two or more different terminals is readily understood. Suppose a case of a group of twelve city blocks in a good section of the city, a mile distant from the central office, each block containing now a half dozen houses, and fifty per cent of the houses having telephone service. Each block contains fifty building lots, additional houses are under construction, and the prospects are bright that in five or six years these blocks will be built up almost solid with houses of good class, and that seventy-five per cent or more of the buildings will have telephone service.

From the main conduit line in the street a branch conduit carrying a 50-pair cable is run into the interior of each block, and suitable means are provided for carrying wires to each present and prospective house. The twelve 50-pair cables contain an aggregate of 600 pairs of wires, and if these were to be all carried back separately to the central office a mile of 600-pair cable would be required for the purpose, and initially but 36 of the 600 pairs, or six per cent would be in use. If the number of working pairs, by doubling each year, should reach 144 at the end of the second year, this would still be but twenty-four per cent of the total, or, as it is often expressed, the cable would be working at only twenty-four per cent efficiency. During these two years the heavy annual charges would have been carried on a mile of 600-pair cable which had been doing less than the work of a 200-pair cable. This making of a large expenditure for cable plant a long time before it can be made to bring in a return in revenue proportionate to the amount of the investment can be largely obviated by proper multiplying of cable pairs.

For instance, in the case under consideration, it is probable that there already exists at or near the location of the twelve blocks a 600-pair cable of which there are 200 pairs now idle, say pairs 401 to 600. The twelve 50-pair cables are spliced to these 200 pairs of conductors, the cables from blocks Nos. 1, 2 and 3 being each spliced to pairs 401 to 450, the cables from blocks Nos. 4, 5 and 6 to pairs 451 to 500, and so on, each series of 50 pairs in the main cable thus appearing in three of the blocks. This makes it possible to serve 50 subscribers in group "A," consisting of blocks 1, 2 and 3; 50 more in group "B," consisting of blocks 4, 5 and 6, etc., and possesses the great advantage of flexibility; that is, if the telephone growth is erratic, and results in

an increase to 40 subscribers in block 1 and only 4 each in blocks 2 and 3, the 48 irregularly distributed subscribers are as well provided for as though there had been an equal distribution of 16 in each of the three blocks. And in like manner if the total number of subscribers in blocks 1, 2 and 3 reaches 50, so that all pairs in the main cable from 401 to 450 are in use, while the growth in blocks 4, 5 and 6 has been small, it is very easy to provide for a further growth in the first group of blocks by merely transferring one of the 50-pair cables in the manhole from one series of 50 conductors to another in the main cable, so that, for instance, only blocks 1 and 2 will be served by pairs 401 to 450 and blocks 3, 4, 5 and 6 will be served by pairs 451 to 500. By such rearrangement of the multiplying, the greatest economy may be secured until such time as each block is fully built up and requires the exclusive use of its 50 pairs all the way back to the central office.

Another reason for multiplying cable pairs is its convenience and economy in furnishing party-line service. This reason was of much more importance several years ago than it is now when nearly everyone prefers his own direct wire to the central office. It is readily seen how, with pairs suitably multiplied, several subscribers in different parts of a block, or in different blocks, may all be connected to the same pair of conductors in the main cable by wiring each to the nearest cable terminal.

In connection with conduit and cable construction the question is sometimes asked why the telephone company cannot connect each building by an underground service, just as in the case of the water, gas and electric light distribution. The principal reasons are very simple. As pointed out above, the several consumers do not each require particular units of these services, but each is tapped on to the large street main which furnishes all customers with varying quantities of exactly the same product. It is unnecesary to make the cross section of the main equal to the aggregate cross section of its services; it will usually be found to be far less in carrying capacity, as it is sufficient that it shall be able to deliver a certain maximum load which is only a small part of the possible load, it being a fact familiar to every one that if all customers should attempt to draw their maximum supply at the same moment, the pressure would drop to but a fraction of its normal value,and no one would receive the electric current, gas or water in sufficient quantities to serve their purposes. But with the telephone, each service, as we noted above, requires its separate pair of conductors all the way back to the central office, and if, after such a service has been established, it is relinquished, the revenue from this individually required plant ceases, while the interest on the investment and other annual charges go on undiminished. When electric light, gas, or water service is relinquished, the only plant which becomes idle is that from the house to the street main, and even this loss is usually "not on the company," if I may so express it, as the investment for such service connections is generally made wholly or principally by the property owner.

With buildings fed by aerial telephone wires from a distributing pole, it is very easy, when house No. 1 gives up its service, to use the cable pair thus released for house No. 2, or No. 20 or No. 40, as the connection may readily be shifted at a cable terminal on a pole or building; but the unavoidable dampness in manholes, and the great number of separate circuits involved, make it essential that all connections in manholes be made in compact, hermetically sealed, lead-armored splices, which cannot be opened for the shifting of connections except at great expense, and then only for a very limited number of times without serious impairment of the cable.

But even this is not all. A water, gas or electric light service once installed is usually suitable for any customer that may occupy the premises. There are exceptions to this, but they are comparatively few. But not so with the telephone service. Last year the occupant of house No. 1, we will say, had party-line service; in the autumn, he moved out and his successor took a direct or individual line, and next year probably another move will be made and the new tenant will contract for a private-branch exchange, all of which requires continual changing or increasing of the cable pairs connecting with the central office. By a judicious application of the principle of multiplying, it is found that some of the practical drawbacks to the plan of running telephone wires into houses underground can be considerably mitigated, but, after all, it appears that the demand for underground connections in Washington is really very slight. The company not only entertains requests for it, but in frequent instances, where handsome residences are erected, suggests and recommends it, on the basis of a division of the excess cost of installation between the company and the subscriber; but the subscriber in most cases rejects the proposition, preferring to have an aerial service installed at the sole expense of the company. I suppose, however, that this is but natural, and that if satisfactory gas and water service could be furnished aerially many persons would take such aerial service with free installation in preference to underground at their own expense.

The foregoing discussion has dealt with underground service for residences and small buildings where in general but one subscriber occupies the premises. For office buildings, hotels, apartment houses, and all other classes of buildings where either a large number of subscribers are to be found under one roof, or where a single subscriber is such an extensive user of the service as to require a number of cable pairs, underground service is usually warranted and usually installed. In such cases the economical method of distribution is generally the following: A branch of one of the main underground cables—which, from their analogy to electric light and power practice are generally called feeder cables—is run into the basement of the building and suitably terminated, 25, 50, 100 or several hundred pairs being provided according to the requirements of the case. A subsidiary cable, called the house cable, is run from the point where the feeder cable terminates and distributed throughout the building, with terminals at the various locations from which the service wires can be most readily carried to the several rooms or apartments. These house cable terminals are usually multiplied, so that if the telephone growth is irregular, and excessive in certain parts of the building, the number of pairs provided will still be adequate. At the point where the feeder cable and house cable are terminated side by side, jumper wires are run from any pair in one to any pair in the other, so that any room or suite may be furnished with any class or quantity of service desired.

As mentioned heretofore, the next

best thing to the exclusive underground service for each building is the exclusive underground service for each block. Having provided a branch of an underground feeder cable to the interior of a block, there are two general methods of completing the distribution, which are subject to all manner of variations and combinations, and both of which are applicable to blocks which have and blocks which have not public alleys.

One, which is so well known as hardly to need description, consists in erecting a pole and terminating the feeder cable upon it, and swinging aerial service wires therefrom to the several houses; or perhaps a line of poles will be required, carrying either crossarms and wires or an aerial cable, by means of which the service wires : e connected with the feeder cable. The other method consists of extending branches of the feeder along the rear walls of the buildings, back fences, etc., and mounting terminals at suitable locations, from which service wires, in twisted pairs with a specially durable rubber insulation, can be carried in metal rings or screw eyes placed on the walls and fences, to each building. Without going further into details here each method has its own advantages, and while in general the method of rear wall and fence cabling and wiring is more economical where there are many telephones in the block, and the pole method more economical where there are few, no set rule can be given for making a choice of method; the local conditions in each block must be considered and the question settled on its individual merits.

I must pass over without discussion the subjects of aerial cables and of the protection of cables from lightning and strong light and power currents, and electrolysis, but I will merely mention an incident that occurred in Baltimore some months ago. The fuses protecting a cable terminal in the kitchen of a hotel were found to open the circuit without apparent cause; an investigation showed that the larva of an insect was harboring in the brass mounted end of the fiber tube which contains the thin narrow strip of metal forming the fuse proper, and this larva seemed o be causing the fuse to part in some manner. We thought we had discovered a new sensation in the shape of another lead-devouring insect, but an authority at the Department of Agriculture promptly identified the larva as that of a certain small scavenger beetle, and explained the entire phenomena by the opinion that larva only occupied the hole in the fuse mounting because it had seemed to the beetle a suitable place to deposit her egg.

WIRE.

There is not time now to go into the subject of pole lines, but a few words about wire may be of interest. In the early days iron wire was used exclusively for telegraph and telephone purposes. Steel was found to be far superior to iron in tensile strength, but with the increase in hardness there was also an increase in resistance, which was a serious disadvantage; the purer and softer the iron, the less its strength, but the greater its conductivity. But even the best of iron wire had two drawbacks: its resistance, when used between distant points, and its tendency to corrode, even though galvanized, when subjected to the smoky atmosphere of the cities. Copper wire did not have either of these objections, but besides being very costly, it was altogether too weak for use on pole lines. For very long telegraph circuits a so-called compound wire consisting of a steel wire, which gave the necessary tensile strength, with a strip of soft copper folded around it so as to form a concentric cylinder, was developed and used to some extent. But a little later the growth of the telephone industry was responsible for the development of hard-drawn copper wire, which, though inferior to steel and but slightly better than soft iron in tensile strength, is yet very satisfactory, and soon came into general use for both telephone and telegraph lines.

At the present time, for aerial subscribers' lines, No. 12 or No. 14 gauge copper wire is mostly used in the city, and in rural districts No. 12 iron is in very general use. For toll and long-distance circuits No. 12, No. 10 or No. 8 gauge copper is nearly always employed. For service wires, both in rear wall and fence distribution and in aerial spans, so called rubber-insulated twisted-pair wire has now been developed to a state which almost seems to approach perfection in its durability and reliability. A compound containing, I believe, something like thirty per cent of pure rubber, was long ago found to possess the necessary insulating and weather-resisting qualities, and at the same time was within reason in the matter of cost, but mechanically it was not sufficiently serviceable. A cotton braiding woven over the insulation gave it the needed protection, but the cotton was subject to rapid deterioration when exposed to the weather. The question then resolved itself into one of preserving the braiding from deterioration, and very satisfactory solutions of this problem have been reached in the present methods of filling or impregnating these braids.

The latest innovation in the way of telephone line wire is the new copper-steel wire which is coming into extensive use, both bare and in rubber-insulated twisted pairs. It is made by a patented process, by which a thin sheath of copper envelops and is thoroughly united to a steel core. It has some transmission advantage over steel or iron wire of the same gauge, and it combines the tensile strength of steel with the corrosion-resisting qualities of copper. Although the cost of copper and of copper-steel wire is about the same for equal lengths of a given gauge, the superior tensile strength of the latter makes it possible in many cases to use a much smaller gauge than with the former, with a consequent saving in cost.

As an evidence that there is no slacking up in the rapid advance of telephone science and art, I will conclude this paper by calling your attention to the striking fact that a comparatively few years ago the greatest distance for satisfactory conversation through c..ble was only something like 15 or 20 miles, so that a subscriber in Harlem or the Bronx, for instance, was going almost the limit when he asked for a connection to a friend in the southern part of Brooklyn; whereas to-day a 92-mile stretch of underground conduit from Wilmington, Del., to Washington, is under construction and nearing completion, and the close of the current year will probably see the consummation of the enterpise—that is, the successful operation of an undegound cable, loaded with Pupin inductance coils, normally handling all telephone conversations between Washington and Philadelphia and New York, and eliminating, or at least making practically negligible, the danger of Washington being cut off from communication with the outside world, as has repeatedly occurred in the past when severe sleet storms have wrecked all overhead telephone and telegraph lines, notably last Inauguration day.

Industrial Power

ELECTRICITY ON SHIPS.

THE DRIVING OF AUXILIARY APPARATUS.

In common with all innovations introduced into ships electricity has had to overcome the strongly deterrent conservatism of marine engineers, and, therefore, in the early days the progress of the application of electricity in ships was utterly incommensurate with that which was being made on land. It must be admitted that the present condition of affairs still leaves much to be desired, but within the last four years developments have been much more rapid.

The advantages of the use of electricity for auxiliary engines in ships are obvious to the electrical engineer, and are conceded by the marine engineer, with whom the objection has always been that electrically operated machines are not so trustworthy as steam engines. The main points which have to be borne in mind in the construction of all electrical plant for ships are simplicity of design, regularity of operation, and cheapness of installation—that is to say, the price should not be materially, if at all, in excess of a steam equipment of a corresponding character. It is well known that a good deal of electrical machinery has been supplied for marine work by manufacturers who have not taken into account the very different conditions which prevail at sea, and, therefore, the hard usage which it has received from the hands of unskilled men has caused serious results which have frequently been described as inherent defects in electrical plant.

There are many systems and methods for the distribution of electricity in ships; the original arrangement—still widely adopted even on some large ships—embodying the single-wire system with a ship return, seems nothing short of a heresy to many engineers. The advantage possessed by this method is the saving in cost of the wiring, but it is gained at the risk of serious trouble, particularly to the ship's compasses, owing to the complicated action of the current on the ship's hull. It is not feasible to employ a higher voltage than 110 with this system, and as the tendency in the future will undoubtedly be to raise the voltage to 220, and thus effect a saving in the wiring, it is more than probable that the single-wire system will become obsolete notwithstanding that the number of vessels so equipped is very large. It may be noted that all the ships of the Hamburg-American Line rely on the single-wire arrangement.

Speaking of English practice the London *Times* says that the general plan now adopted both in England and elsewhere is the two-wire distribution at 110-120 volts, and it will no doubt appear strange to many electricians that, if the cost of wires is so heavy, a higher voltage should not become more general. The saving which could be effected is indeed great, since in a very large ship the cables and wiring may run to anything in the neighborhood of $25,000 to $50,000, and a reduction of this amount by about fifty per cent seems to be worthy of consideration. The main objections have always been the supposed personal danger involved and the liability of breakdown of insulation, both of which, to the land engineer, appear to be somewhat mythical. These points have, indeed, been much exaggerated, chiefly owing to a lack of knowledge regarding the safety of electricity, and to the disastrous experiences resulting from shoddy and badly supervised work. It may be mentioned that in the case of the *Mauretania* the Cunard Company was strongly advised by those responsible for the electric installation to adopt 220 volts for the supply, but they refused for these reasons. Of course, in an atmosphere which is always more or less damp the danger to insulation is rather more serious than on land, but with ordinarily efficient work there is practically no risk of trouble. There is now a tendency, particularly in naval vessels, to adopt a higher voltage, and most of the British warships are being equipped with electrical installations of 220 volts on the three-wire system. As it is a general rule for mercantile vessels to follow naval practice where possible, it is probable that for larger vessels where the cost of wiring becomes an important item this system will in the future become quite usual.

In regard to the type of generating plant use at sea, vertical high-speed engines of the Belliss and Morcom or Allen type have been generally adopted, and marine engineers had become so accustomed to these machines that when it was decided to install comparatively large turbo-generators on the *Mauretania* and *Lusitania* many misgivings were expressed at such a radical departure. The result has proved very successful, however, and since that time turbines have been very widely used, particularly in foreign vessels, and in fact the necessity has led to a type of turbine special-suited for ships' work since it is essential that the engines should be capable of working against a considerable back pressure in order to provide steam for feed heating. Another innovation which has now proved of the utmost importance is the installation of one or more generators driven by Diesel engines to act as a stand-by to the steam plant, the advantage of this being the readiness with which it may be started up, and the immunity from any accident which might disable the entire steam-driven sets. It may be mentioned that Diesel engines have been employed on every large battleship in the British Navy since the first dreadnought was built.

The first requirement of electricity in ships is in connection with lighting, but in the larger vessels the proportion of power employed for this purpose, compared with the whole output, is relatively small, and it is perhaps for this reason as well as on account of the fragility of the metallic-filament lamp that it has generally been decided not to install this type at sea. The cost of current generated in any case is small, and although within the last year or two a few vessels have been supplied with metallic-filament lamps, which appear to have given satisfactory results, there is always a risk of costly renewals, and it is hardly likely that these lamps will ever obtain wide adoption.

Heating and ventilation have always been difficult problems at sea, both in passenger boats, where there are so many

people in a confined space, and in battleships, for the further reason that it is necessary to supply cool air to powder magazines, etc. The method now commonly adopted is the employment of thermo-tanks in which air is drawn by motor-driven fans from the atmosphere over a series of coils, and led through ducts into the various cabins and rooms. The coils may be heated by steam or cooled by brine, and, moreover, by a suitable arrangement of valves, air may be drawn from the rooms instead of fresh air being supplied. The size of motor usually employed for this work is from 2 to 3 horsepower, and as there may be some 30 to 40 tanks (or more in very large vessels), nearly 100 horsepower may be needed.

In all battleships and fast liners forced-draft fans are installed for producing the necessary draft for the rapid raising of steam from the boilers. These fans are of considerable size and require a large amount of power. In the *Mauretania* there were eight electric motors of fifty-horsepower each coupled to two fans, or a total of 400 horsepower in all, the average power required when the vessel is at full speed being well over 200 horsepower. Up to four or five years ago steam-driven fans were almost universally adopted, but the electric motor has many advantages for this work, such as ease of operation from the stokehold, small attendance, economy of working, and the absence of steam piping, so that now it is not surprising to find it being more frequently adopted. The design of motors used for this purpose needs some care, as a wide variation of speed is required; and trustworthiness must be beyond question, since the speed of the vessel is absolutely dependent on the fans.

Electric capstans and winches are gradually finding favor at sea, though not without some opposition; but there can be no doubt that eventually they will be universally employed, since the inconvenient steam piping, condensation losses, and trouble with freezing associated with steam winches cannot be tolerated for long. Here again it is essential that the motors employed should be specially adapted for the work, and should embody the strongest construction of machine so that it may operate satisfactorily under the worst climatic conditions and with the greatest carelessness in handling. It has been proved by long experience, however, that there is no difficulty in producing such a motor, with the result that electric capstans and winches are every day becoming more common.

Cranes, boat hoists, and passenger and freight elevators are essential on all large vessels, many of which have four of each. Here electricity has full scope, with the experience gained on land with similar appliances. In warships motors are also employed for ammunition hoists, and in spite of one or two unfortunate experiences they have proved eminently successful. In the engine-room the electric motor has many uses, for with its absence of stand-by losses it possesses marked advantages over the steam engine. In battleships and large liners where turbines are installed means have to be provided for raising the covers and rotors, and this is readily accomplished by motors of 10 to 30 horsepower, driving through gearing the lifting screws. Motors are also necessary to operate the large exhaust valves for turning the shafting, to drive large ventilating fans, etc.

Marine engineers have not yet put their trust in electricity to the extent of relying upon it solely for the operation of the refrigerating machinery, but in one plant of the two duplicate sets the compressor is frequently motor-driven, and also the brine and water-circulating pumps. Belt-driving is of course impossible, owing to the limitation of space, and a motor with a wide variation of speed is usually coupled through gearing to the crank-shaft of the compressor. It says a good deal for the growing recognition of the advantages of electricity that a machine eminently adaptable to the steam-engine drive should in so many cases have been converted to electric operation.

There are innumerable minor applications of electricity at sea, the number of which is always extending—cooking and domestic utensils, telephones, bulkhead door closing and indicating mechanism, and many others. Steering gear also is frequently operated electrically. Steering by electricity offers many advantages, and there is little doubt that once the experimental period be passed the method will be widely employed.

The tendency in all ships is evidently towards the ultimate replacement of all steam-driven auxiliaries by electricity, a consummation that may be hastened by the coming of the gas engine boat, in which the provision of a boiler solely to drive the auxiliaries will be obviously anomalous.

Power in Factories.

The cost of power in a factory is largely dependent upon the horsepower required. Where the amount of power runs into thousands of horsepower the class of generator can be one which is inadmissible in the case where only twenty, thirty, or a few hundreds of horsepower are required. Hence comparisons of cost per horsepower-hour do not serve in every instance, and only tend to defeat the real object in view.

There are various points to be taken into account which affect more particularly works and factories of small dimensions. In many of these concerns there is not, as a rule, much capital lying idle, and what there is can generally be better employed in the purchase of revenue-earning machinery and the replacing of less efficient tools. It is thus out of the question for owners of small factories to consider the cost of generating plant with the tempting prices for power now held out by electric power supply companies. The fact that the question of cost of power is a debatable one is evidence that the figures put forward by interested parties approximate one another.

Let us for a moment see, roughly, what these figures are, and to do this it is necessary to fix upon a definite power requirement, say 400 horsepower working on an average of ten hours per day. Tests have shown that a high-class compound condensing engine will take 1.75 pounds to 2 pounds of coal per horsepower-hour, and the fuel, together with oil, water, repairs, maintenance and wages, will total about $0.38, or with interest on capital outlay $0.58 per horsepower-hour. A non-condensing engine will cost less to install, but the fuel will be more, the total being, perhaps, $0.60 horsepower-hour. The alternative power plants to be conceived, are gas and oil engines, the former working with suction gas and the latter with crude or paraffin oil. With a modern design of engine, and working on similar load to that taken by the steam engine, the cost works out to approximately $0.66 per horsepower-hour.

From these figures it will be seen that there is not a very great deal of difference between the cost of power generated by the steam engine with its boilers, the suction gas engine with its producer, and the oil engine. But

there are local circumstances which may decide the turning points, such as convenience for coal storage, the space which boilers and engines or producer-gas plant will occupy, rate of wages, etc.

One wonders why it is that the supply of electric power from large power generating stations is sometimes so high, in view of the enormous outputs, high load-factors, and low cost of fuel. The answer is, that the distribution costs, through capital outlay and interest for mains and transformers, are about equal to the cost of generation.

Where there is no dearth of capital or want of floor space, it is advantageous for a plant taking not less than 1,000,000 units per annum to generate its own power, while it is a case of going closely into the relative merits of the types of power generators mentioned above, and to determine with accuracy the best to adopt for a particular purpose.

Where the requirements of power are on a much lower scale, then it is shown that the figures for attendance, fuel and the lower engine efficiency return cost outweighs the the advantage secured by large units. Further, by taking power from an electric supply company, there are no unremunerative hands employed, and with intermittent demands the cost is proportionate to the power used, with only a small standing charge to cover rental of motors during slack periods.—*The Practical Engineer.*

Prevention of Scale in Boilers.

It has been discovered by a man in Hanover, Germany, that if hard water, previous to being fed into a boiler, were allowed to run over a plate of aluminum set at an angle and exposed to sunlight or diffused daylight, no scale would be formed through the action of such water on the boiler plates or tubes. The solid matter contained in the water deposits as a fine mud, which is easily removable on the lowest part of the boiler, consequently the tedious process of chipping off the scale is obviated.

This process was tried at the Proprietary Company's Port Pirie Works, Broken Hill, Australia. Two plain aluminum sheets, each four feet by two feet were fixed in a frame inclined at an angle of fifty-nine degrees, facing the sun. Water from the main was then allowed to flow over the plates from a perforated pipe fixed at their upper edge. A sufficient quantity of the water was run over the plates in the day time and stored to supply a Lancashire boiler for twenty-four hours.

Aluminum Busbars.

An article published in a recent number of the *Electrical Times* (London). gives an excellent idea of the work which is being done in England in the way of substituting aluminum for copper as a busbar material. Aside from the decreased cost, it has been found in the plant described, that the increased care used in the construction work resulted in a better installation.

The Dale End substation, which was described, is one of the stations of the Birmingham Electric Company and converts a high-tension supply to a low pressure for distribution in the center of the city, and also distributes incoming low-tension current. There are sixteen feeder panels, each fitted with gear for controlling positive and negative circuits. In addition there are two neutral feeder panels, three balancer panels, one plant-supply panel, one Board-of-Trade panel and others. The whole of the busbars and the back connections shown are made entirely of aluminum, the connections being clamped to the busbars throughout by heavy solid clamps. The busbars have a maximum cross section of fourteen square inches.

In connection with further general remarks, the statement is made that the clamps and other common forms of mechanical joints used in the erection of copper busbars and switchboard connections are equally effective when aluminum is used as a conductor. For heavy currents the bars are usually built up in laminated form with aluminum spacing pieces under the clamps. The contact surface, which should be liberally proportioned, must be perfectly flat and free from grit or other foreign matter. No foil is employed between the contacts, but before clamping up, the surfaces should be roughfiled in opposite directions. It has been found that the slightest trace of vaseline applied to the surface improves the contact. Some busbar contacts, made in 1907, were tested recently and found not to have deteriorated in the slightest.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company, for the month of June and six months ended June 30, 1911, compares as follows:

	1911.	1910.
June gross	$ 681,502	$ 650,605
Expenses	326,349	301,677
June net	355,153	348,927
Charges and taxes	140,079	140,112
June surplus	215,074	208,815
Six months gross	3,781,952	3,582,248
Expenses	1,928,794	1,748,128
Six months net	1,853,158	1,834,119
Charges and taxes	840,475	841,141
Six months surplus	1,012,683	992,978

PHILADELPHIA COMPANY.

The Philadelphia Company and affiliated corporations report for the three months ended June 30, 1911, compared as follows:

	1911.	1910.
Gross earnings	$4,917,360	$4,954,276
Expenses and taxes	2,922,678	2,699,575
Net earnings	1,994,682	2,254,695
Other income	48,693	53,266
Total income	2,043,375	2,307,961
Fixed charges	1,222,386	1,224,764
Balance	820,989	1,082,197
Improvements, betterments and extensions	299,567	89,294
Surplus	521,422	993,903
Prop. due outstanding stock affiliated corporations	862	813
Available for Philadelphia Company	520,560	993,089

Items representing transactions between companies have been eliminated in this report.

KEYSTONE TELEPHONE.

The report of the Keystone Telephone Company of Philadelphia, for the month of June and twelve months ended June 30, 1911, compares as follows:

	1911.	1910.
June gross	$ 97,045	$ 97,990
Expenses and taxes	46,274	45,307
June net	50,771	52,683
Interest	24,446	24,946
Surplus	26,325	27,737
Twelve months gross	1,153,788	1,126,030
Expenses and taxes	572,004	558,079
Twelve months net	581,784	567,951
Interest	293,383	302,755
Surplus	288,401	265,196

WEST PENN TRACTION.

The West Penn Traction Company reports for the year ended June 30, 1911, as follows:

Gross	$2,071,883
Expenses	1,015,878
Net	1,056,005
Charges	617,248
Surplus	438,757
Preferred dividend	97,500
Surplus	341,257

AMERICAN LIGHT & TRACTION.

The American Light & Traction Company reports earnings for the twelve months ending June 30, compared as follows:

	1911.	1910.
Earnings on stocks of subsidiary companies	$3,564,292	$3,222,230
Miscellaneous earnings	478,539	376,262
Gross earnings	4,042,831	3,598,492
Expenses	117,957	110,151
Net earnings	3,924,874	3,488,341
Previous surplus and reserve	6,341,110	5,513,587
Total surplus	10,265,984	9,001,928
Cash dividend preferred	854,172	854,172
Cash dividend, common	1,047,972	857,363
Stock dividend, common	1,048,170	949,282
Total dividends	2,950,314	2,660,818
Profit and loss surplus	7,315,669	6,341,110

New Electrical and Mechanical Apparatus and Appliances

GAS-ELECTRIC CAR FOR SAN FRANCISCO RAILROAD.

The gas-electric motor car with its reliability, low operating cost, flexibility of control combined with luxurious accommodations and freedom from cinders, smoke and coal gas, has apparently found its place among railroads as a commercial success.

The six gas-electric motor cars which the St. Louis & San Francisco Railroad Company has purchased, are from the latest designs of the General Electric Company.

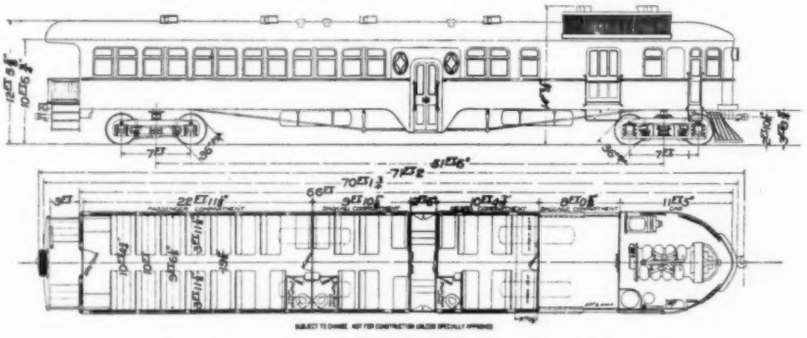
The cars are 70 feet long and 10 feet in width over the sills, with turtleback construction of roof, pointed front end and observation rear platform. The cars are designed with special reference to light construction with adequate strength. The interior arrangement is designed to meet the southern traffic conditions, providing separate accommodations and entrances for white and colored passengers. The observation platform is unusually wide and is equipped with trap doors and brass railings, presenting a most attractive appearance.

The interior of the car is finished in a high-grade of mahogany with paneling on the bulkheads. Each of the three compartments is provided with a saloon and drinking fountain. Electric fans are installed in each compartment.

The seats are of unusual length providing commodious accommodations for two persons and are amply large enough to seat three. These are of the stationary back type with high-grade spring construction in both seat and back cushions, the former being provided with a spring edge adding greatly to the comfort of the passengers. The upholstering of the seats in all compartments is the latest in railroad practice. Ventilation is accomplished through large suction ventilators located on the center of the roof, the openings protected by neat ceiling register plates. The entire car, including platforms and vestibules, is lighted by electricity.

The frame work of the car is entirely of steel, the under framing consisting of two I-beams for center sills, and two channels for outside sills with truss rods for reinforcement. The center sills extend through to provide suitable supports for the rear platform. The outside sheathing is of sheet steel rivoted to the posts with bats at the joints. The posts and carlines are of steel tees. The roof is of galvanized iron plates riveted to the carlines, except under the radiators, where it is of copper with well-soldered joints.

The car is heated by hot water circulating in four lines of pipe on each side of the car. The front end of the car only is equipped with a pilot, inasmuch as the car is primarily for single-end operation. Equipped and ready for operation, the car will weigh in the neighorhood of forty-eight tons.



PLAN AND SIDE ELEVATION OF GAS-ELECTRIC CAR.

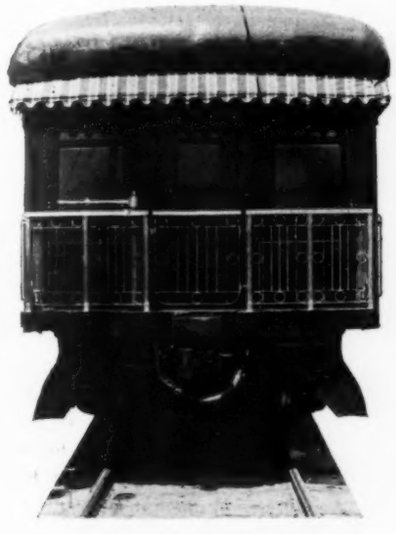
The power equipment is located in the cab at the front end of the car, and consists of the following: A main gas-engine generating set, consisting of an eight-cylinder gasoline engine with direct-connected generator, an auxiliary gas-engine generating set with integral air pump and lighting generator; equipment for motor control: air and hand-brake systems; pneumatic bell ringer; sander; warning and signal whistles and a coal-fired hot-water heater. The motors are mounted one upon each axle of the front truck.

The main gas-engine is of the eight-cylinder, four-stroke cycle "V" type. The generator magnet frame is bolted to the frame of the gas engine which rests upon the floor of the car with cushion support. The speed of the engine is adjusted by a throttle, the normal speed being 550 revolutions per minute. The cylinders are eight inches in diameter with ten-inch stroke. The base and crank case are of cast iron and suitable hand holes are provided in the base for the inspection of the main bearings and big ends. The cylinders are of close-grain gray cast iron with water jackets integral. The cylinder heads are removable with separate integral jackets. The pistons, of trunk type, are of close-grain cast iron. Each piston is provided with five cast-iron snap rings, four above and one below the piston pin. The piston pins are of steel hardened and ground, fixed in the end of the connecting rods with two bearings in the piston. The connecting rods are of carbon steel forged and oil treated. There are two cam shafts, one on each side of the engine and these ar made from forged rolled-steel shafting, while the cams are of high carbon steel, oil tempered. The cam shafts are located in tunnels with covers so arranged that they may be easily removed. The ignition system consists of two low-tension Bosch magnetos, one for each side of the engine, with Bosch magnetic spark plugs. All wires from the magnetos to the spark plugs are inclosed in a brass hand rail, so that there are no loose or exposed wires. The engine is lubricated by oil under pressure, delivered by a plunger pump direct driven from the crank shaft. Gasoline is delivered by a direct-driven

pump to the carburetors which are of the automatic constant-level type. The engine-cooling system consists of thermo-siphon circulation of the water in radiators of fin-tube type, which are located on the roof of the car with flexible metal-tube connections from the engine to the raidator headers. The engine is started by air stored in tanks beneath the car, which may be charged from the auxiliary gas-engine set or from the main compressor located at the rear end of the main engine and direct driven from the crankshaft. The main compressor has a capacity of 22.5 cubic feet of free air per minute.

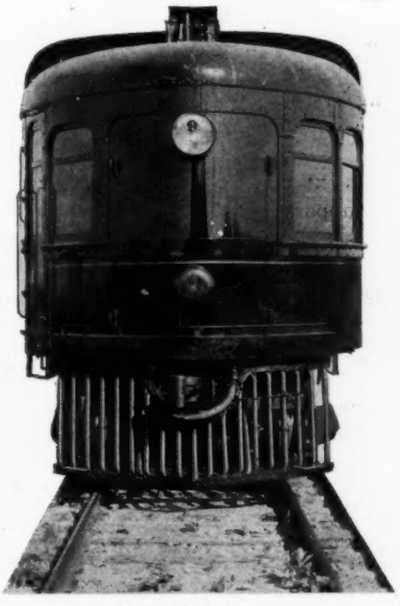
The main generator is of the commutating-pole type designed specially for heavy traffic. The entire machine is inclosed within a three-arm bracket which supports the outer bearing of the generator armature.

The motors are of the box-frame, commutating-pole, oil-lubricated type known as standard General Electric 205-600-volt 100-horsepower railway motors. Current to the motors is supplied through cables in conduit, from the generator.



OBSERVATION PLATFORM.

The auxiliary gas-engine set consists of a three-cylinder, four-stroke cycle, vertical-type gas engine, the center cylinder being used as an air compressor. The lighting generator is direct connected to the gas engine with armature of the overhung type. The construction of this engine is similar to that of the main engine. Lubrication is of the constant-level splash system, the level and circulation being maintained by a paddle-wheel pump. A fly-ball gear-driven governor acting on a butterfly valve in the intake pipe is used to maintain a constant speed of 600 revolutions per minute. The cooling system for this engine is the same as for the large engine. The air pump



FRONT END OF CAR.

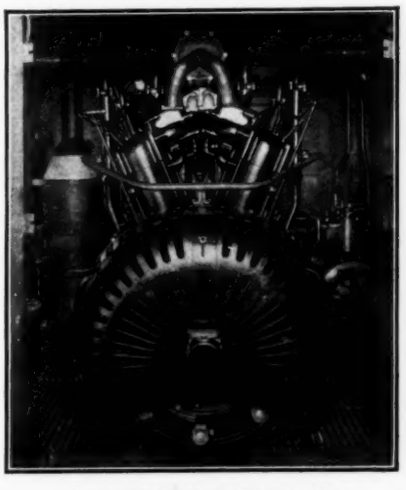
on this engine is capable of delivering forty-five cubic feet of free air per minute and will charge the tanks to a pressure of ninety pounds in about ten minutes. This pump is used to supply air for starting the main engine after it has been idle if pressure in the main reservoirs has gone down. The auxiliary gas-engine is started by hand.

The operator's seat is at the right hand side of the cab beside a sliding window. All the control, air-brake, and signal apparatus is conveniently located at this point and so arranged that the car and engine may be controlled without the operator leaving his seat.

One of the distinguishing features of these cars is the flexibility of control. Power is delivered to the motors from the main generator through a controller of a type similar in appearance to those used in trolly-car practice. Concentric with the electrical controller handle, but above it, is an air-starting throttle handle. This handle is so arranged that by pressing a lever, air for starting the engine may be admitted to the engine distributing valve through an air valve mounted upon the car plate of the controller at the same time opening the throttle. Provision is made, however, so that the throttle may be open only to a set distance to prevent the racing of the engine. The engine started, the lever may be released, cutting off the air pressure and the throttle opened wider. It is not possible to admit air again to the engine without returning to the initial point, thus closing the throttle. The direction of the car may be reversed in a manner similar to that employed on a trolley car, by the moving of the reversing handle, the gas engine always running in the same direction.

The brake system consists of straight and automatic air with auxiliary hand brakes; the handles, which are of the Lindstrom type, are located one in the cab convenient to the motor, and one on the rear platform. The air gauges are located on a panel immediately in front of the operator.

As stated before, the car in lighted with electricity, power being supplied from the lighting generator driven by the auxiliary gas-engine. There is a voltmeter on the panel together with the air gauge and a rheostat box is mounted on the wall of the cab, so that the operator may regulate the lighting



GAS-ELECTRIC UNIT IN CAB.

voltage as desired. There are two circuits, one on each side of the car, for the passenger and baggage compartments with an additional circuit for fan motors. Each lamp is fitted with an attractive shade. The electric lamps in the cab are protected by glass globes inclosed within steel cages. Condulets for attachment plugs are also provided, one on either side of the cab. The headlight is equipped with a 50-candle-power bulb, and there is also provided a gauge light which is controlled by a switch convenient to the operator;

the gauge and headlights are on a separate circuit from the cab lights. Switches and fuses for the lighting circuits are mounted in a cabinet fastened on the wall.

The car is heated by hot water either supplied from the gas-engine jackets or from a coal-fired Baker hot-water heater located in the corner of the cab, which is fired from the baggage room. Provision is made so that hot water from the coal heater may be circulated through the engine jackets and radiators to prevent freezing on cold nights or during layovers.

The gasoline storage tank is located beneath the baggage room.

Gasoline is supplied to the tank through a filler on the outside of the car with suitable strainers and filters There is in addition a vent pipe to the roof.

There are three air reservoirs located under the car and so arranged that the air taken from these reservoirs for starting the engine does not drain the brake reservoirs. There is also a reservoir for the signal and warning whistles.

The trucks are of the swing-bolster type, the frames being of boiler-plate steel with pedestal shoes of cast-iron. The bolster springs are triple elliptic and the equalizer springs triple coil. The wheels are thirty-six inches in diameter with standard M. C. B. treads and frames. Each truck has a wheel base of seven feet, the total wheel base of the car being fifty-eight feet, six inches.

Great Northern Railway Extends Telephone Train-Dispatching Service.

The Great Northern Railway, which already has nearly 4,000 miles of track equipped with telephone train-dispatching equipment, has just placed an order with the Western Electric Company for thirty-two telephone selectors to equip its Cascade Division.

The circuit will be divided into two sections. The first will extend from Tye, Wash., to Everett Junction, Wash., with a branch from Monroe to Tolt, Wash., and another from Pacific Avenue to Delta, Wash. The second section will run from Tye to Leavenworth, Wash. The distance covered by the first section will be ninety-three miles, while that covered by the second will be thirty-six miles. The dispatcher for both circuits will have his headquarters at Tye.

New Fire-Alarm System in Springfield, Mass.

The fire department of the City of Springfield, Mass., has just completed the installation of a new fire-alarm system of the Gamewell type. Superintendent Samuel L. Wheeler of the department, to whom much credit is due for the work of the new system, began switching the new system into service on July 31. Within ten minutes from the start the new system was in operation, but during that short period of time not a single box was out of commission and if an alarm was sounded the box would have come in over either the old or new system.

The old system consisted of ten circuits, all the boxes and other apparatus being on slow time; that is, the blows coming in two and one-half seconds apart. The new system consists of thirty-two circuits, with all the boxes speeded to one second between blows, so that the alarm will be received two and one-half times as fast as was the case with the old system.

As long as the bells and whistles are used for a public alarm, and as it is impossible to strike a bell or blow a whistle on one-second time, six circuits have been established over which the alarms will be sent at slow time after the alarm has been repeated to the engine house. It will be seen, therefore, that the apparatus will be on its way to the fire before the public is aware of its location.

The receiving and transmitting devices consist of seven Italian marble switchboards, covered with the various switches and devices for controlling the thirty-two circuits. These switchboards are incased in handsome steel cabinet work, enameled in imitation of mahogany.

The registers, repeaters and other transmitting devices are located in the center of the room on pedestals made of the same material.

The alarm is operated by 1,200 cells of storage battery located on iron, glass and porcelain racks immediately in the rear of the operating room.

INTERIOR OF NEW FIRE-ALARM STATION.

The wires connecting the various switchboards with the battery pass through iron conduits laid in the cement floor when the building was constructed.

There is no wood or other inflammable material used in the entire office.

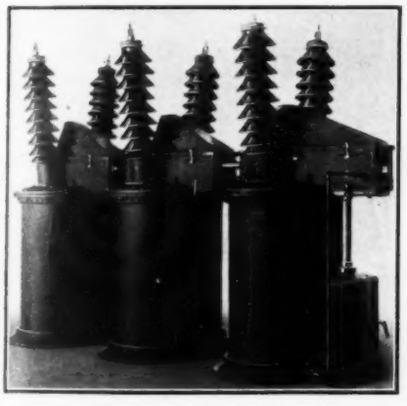
Some ten miles of wire have been used in the office in connecting up the various pieces of apparatus to their respective switchboards, none of which is in sight. All outside wiring, connecting the various boxes with the station, is of Okonite manufacture.

As soon as a box is pulled for a fire, the number will be struck on a bell, the same number will be perforated on a strip of paper in one of the registers,

two red lights will be lighted on the operating board showing the circuit from which the alarm is being received. The operator will then have three different methods of sending the alarm to the fire department and the public.

Immediately upon receipt of the first round he will press a key which will give a warning blow throughout the city and release the horses and notify the department that an alarm is coming. Between the first and second rounds, by the simple throwing down of a lever he transfers the office to an automatic. The second, third and fourth rounds will go direct to the engine houses on fast time. An ingenious device known as the rapid transformer slows the alarm down and after the second round, gives the alarm to the bells, whistles, and to a separate set of circuit reaching each department house.

A second method is as follows: As soon as the first round is received, the operator sets the number of the box on a dial transmitter. This transmitter immediately sends the alarm to the engine houses on fast time and after the second round changes the time and its



WESTINGHOUSE OUTDOOR-TYPE CIRCUIT-BREAKER.

connections so that two rounds are sent out over the slow-alarm circuits.

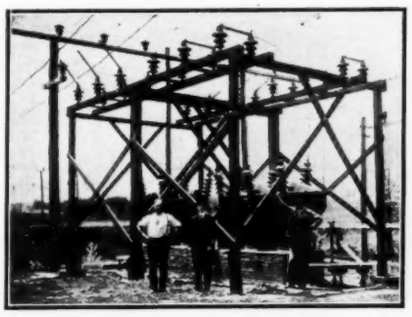
The third method is by the use of a multiple key whereby the alarm can be sent out manually.

It will thus be seen that two sets of circuits are provided to each fire station and three methods of sending the alarms over either set.

This system has been under construction for about a year and a half and is being installed by the Gamewell Fire Alarm & Telegraph Company of New York, under the personal supervision of Samuel L. Wheeler, superintendent of fire alarm.

OUTDOOR-TYPE OIL CIRCUIT-BREAKERS.

The rapid growth in recent years of high-tension tranmission systems has developed a demand in many places for apparatus capable of being installed



THREE-PHASE OUTDOOR TYPE IN SOUTH.

out of doors. The particular field of application for such apparatus is at points along the lines of high-tension transmission systems, where there is a demand for electric energy, but where this demand is not sufficiently large to justify an expenditure sufficient to build and equip a substation. By the use, however, of outdoor type of apparatus, it is often possible to save the cost of the substation building and eliminate the other costs incident to the erection of such a building.

As a result of this demand, a line of outdoor-type transformers has been designed and successfully applied to this work. The logical result of this was an out-door type high-tension switch for controlling the circuit.

The Westinghouse Electric & Manufacturing Company has met this demand by a modification of the type GA oil circuit breaker which has been most successfully used for some years past.

The breaker itself is the same as the indoor type with a weatherproof protection for the operating mechanism and terminals as shown in the accompanying illustrations.

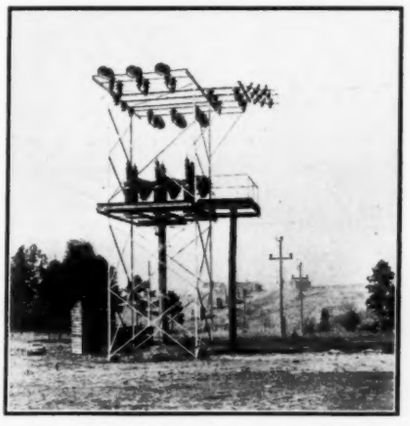
The type GA breaker is made for either hand or electrical operation, automatic or non-automatic, for use on circuits of from 44,000 to 110,000 volts, 300-amperes capacity.

Each pole is a separate and distinct unit and a multipolar breaker consists of two or more units connected together by the operating or pull rods working to contacts and tripping mechanism.

The tanks are made of heavy, welded, boiler sheet iron with an insulating lining. Each tank is provided with a cast-iron cover securely bolted to a flange riveted to the upper edge of the tank upon which is mounted the operating mechanism.

The tank is filled with a high-grade insulating oil, the height of which may be determined by a sight gauge near the top of the tank. Where the pull rod passes through the tank, it is surrounded by a stuffing box which acts as a wiper and removes the oil from the rod and prevents its being thrown over the operating mechanism, a point that will be greatly appreciated by operators.

The upper or fixed contacts are firmly secured to the lower ends of the leads which are the well known condenser type originated by the Westinghouse Company. This upper contact consists of a circular piece of brass of greater area than the moving contact, which insures the entire surface of the latter bearing upon the stationary upper contact. With this construction the necessity of accurately centering the contacts one upon the other, is eliminated. The lower or movable con-



CIRCUIT-BREAKERS ON TRANSMISSION TOWER.

tacts are carried by a heavy metallic cross-bar and consist of pieces of cylindrical brass rod backed by compression springs which insure alinement.

Electrically operated breakers are equipped with operating coils wound for direct current, standard voltages. They are also equipped with a telltale device consisting of a double-throw knife switch and colored lamps which indicate the position of the contacts.

The automatic breaker may be tripped by current from standard series transformers, mounted at any conveni-

ent point, or special transformers built around the leads of the breaker. The latter method is considered standard and is usually furnished when tripping current is 100 amperes or over. Another method of tripping is furnished by a series relay which operates in connection with springs to trip the breaker. This device is suspended from high-tension insulators immediately above the breaker and an insulating mechanical connection is made to the breaker. The actual power for tripping is furnished by the springs which are compressed when the breaker opens, the relays being required to trip only the latch releasing the springs.

In order to adapt these breakers to outdoor use, a housing is placed over the operating mechanism and rain shields over the condenser terminals.

The housing over the operating mechanism consists of a cast-iron cover which is cast into and forms an integral part of the cover of the breaker. It is cast in two parts which are securely bolted together, and hinges are provided which permit the upper portion to be raised for the purpose of inspection of the mechanism.

In the electrically operated type of breaker, the operating solenoid is also protected by means of a cast-iron housing, and the operating leads are brought out through brass bushings, thus permitting the use of lead cables and wiped joints.

With this type of breaker there is also furnished a small knife switch mounted under the housing for controlling the incandescent lamps which may be placed at any convenient point to indicate the position of the circuit breaker contacts.

There are many problems involved in the design of outdoor high-tension oil switching apparatus and without doubt the most exacting one is to secure a method of successfully bringing the high-voltage leads through the tops of the iron tanks.

With the introduction of the condenser-type terminal, with which the GA breaker is equipped, the problem is much simplified, as this terminal lends itself very readily to weatherproof protection by means of porcelain rain shields.

These shields are porcelain petticoat insulators slipped over the terminals and securely fastened thereto. This construction is clearly shown in the accompanying illustration.

The shields are secured to the terminal on the inner side by a waterproof gum and on the outer side where exposed to the weather by a waterproof cement. This form of construction prevents absorption of any moisture by the terminals and renders them entirely waterproof.

The operation of the circuit-breaker is not affected in any manner by the addition of the weatherproof attachments and it can be opened and closed just as readily as the indoor type.

The breaker is usually mounted on a wooden platform and placed within an enclosure to prevent any one not authorized from tampering with the mechanism.

A large number of type GA outdoor breakers have been installed on the lines of the Southern Power Company, which traverse over 1,300 miles of that portion of North and South Carolina known as the Piedmont Section. In this region there are experienced very great extremes of temperature during short periods, as well as excessive moisture, especially in the winter months; and during the summer months there is an average of one rain and lightning storm every day. These conditions subject outdoor apparatus to very severe tests and the Westinghouse Company states that the 44,000 and 88,000-volt GA breakers have more than justified the confidence placed in them.

One of the particular applications this company has made of these breakers is their use as sectionalizing switches in parallel lines of loops which have been built to insure continuity of service. By this means a defective portion of a line can be cut out and a good line cut in without any interruption to the service which, of course, would not be possible by the use of disconnecting switches alone.

Some of these breakers are also used in testing the lines to locate trouble and in such use are often thrown on short-circuit or dead grounds and are thus subjected to very severe service, but they have withstood such tests in a manner entirely satisfactory to the engineers of the operating company.

On the 100,000-volt double-circuit steel-tower trunk line which feeds several of the larger towns in North Carolina, the Power Company desired some means of supplying certain customers from either one of the two lines which might or might not be operating in parallel. This was accomplished by using two GA outdoor type oil circuit-breakers and mechanically interlocking them so that but one breaker could be closed at a time, in effect a three-pole double-throw breaker.

Changes in Fostoria Glass Specialty Company.

The manufacture of upright air-hole gas chimneys (but not of shades and reflectors for gas burners) has been discontinued by the Fostoria Glass Specialty Company at Fostoria, Ohio, as the Company's plant capacity is taxed to keep up with the growing demand for the higher grades of glassware, particularly of the iridescent variety. The new Fostoria Glass factory at Niles, Ohio, is now being operated at full capacity.

The following changes have recently, although not concurrently taken place in the management and personnel of the Fostoria Glass Specialty Company: E. O. Cross has succeeded M. H. Lemen, retired, as manager of the Company and R. E. Briggs has been appointed assistant manager in general charge of sales. B. C. Coleman, who has just concluded five years of successful experience in the fixture business, will be the Company's Western representative. while the Eastern territory will be covered by Raymond P. Adams, formerly of the Engineering Department of the National Electric Lamp Association.

Insulators of Unusual Strength.

An insulating substance of great toughness is being introduced in England and the claims made for it should appeal to telegraph and telephone companies. It is claimed that insulators made of this special composition are bullet-proof as well as unbreakable. The material is weather-proof and almost indestructible, and the screw threads are accurately cut, so that they are easily fitted to the supports, without the use of cement.

The insulation resistance of the insulators, as tested in water at Faraday House, was over half-a-million megohms. After seven deys' immersion in brine, the insulation resistance was about 100,000 megohms, and on applying an alternating pressure at fifty cycles per second the insulation was not broken down until pressures exceeding 13,000 volts were attained. Fired at with a shot gun the insulators showed merely superficial injuries.

Reserve Current for Electric Lighting and Power Companies.

Electric lighting and power companies fully appreciate the value of having a reserve supply of electricity so that their customers can always be assured of an uninterrupted service. They realize that to operate their plants without a reserve of current is to always incur the risk of interruptions with consequent trouble to their customers; while on the other hand a proper reserve of current forms a highly valuable insurance.

For these reasons many of the large electric lighting and power companies have recently installed enormous storage batteries capable of furnishing a large portion, if not the entire amount of current necessary for short periods of time.

Among the electric lighting companies which have installed these large emergency storage batteries are those operating in New York, Chicago, Boston, Brooklyn, Baltimore, Spokane, Minneapolis, Kansas City, Rochester, etc. The New York Edison Company alone has forty-six emergency storage batteries which aggregate a capacity of 64,583 kilowatts at the emergency rate. In other words these batteries will furnish 86,572 horsepower which is sufficient electrical current to light 2,583,320 twenty-five-watt tungsten lamps for twenty minutes.

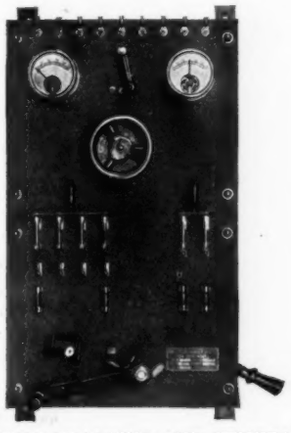
The storage batteries of the Commonwealth Edison Company, in Chicago, have a capacity of 59,121 horsepower, in Boston, 17,116 horsepower; in Rochester, 7,085 horsepower; in Spokane, 4,210 horsepower; in Minneapolis, 7,049 horsepower, and in Kansas City, 5,231 horsepower.

An emergency storage battery is now being installed by the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., which, it is said, will be the largest storage battery in the world. The total weight of this battery when equipped with lead plates and battery fluid will be approximately 1,079,200 pounds. The battery will have an output of 5,517 kilowatts, or 7,395 horsepower, sufficient electric current to light 220,680 twenty-five watt tungsten lamps for twenty minutes.

In each of the cities mentioned the batteries chosen for this purpose have been the "Chloride Accumulator" and the "Exide" battery, both manufactured by the Electric Storage Battery Company, of Philadelphia. The "Exide" emergency battery has been particularly designed for this service and due to its high discharge rate with high voltage, small floor space, light weight, and low cost per kilowatt output, meets the requirements of this service.

Battery-Charging and Generator Panel for Private Plants.

Where central-station service is not available as in country homes, and hotels and on farms electric service is now becoming common, due mainly to the development of gasoline-engine generating sets and storage-battery auxiliaries. The accompanying illustration shows an inexpensive, compact battery-



BATTERY-CHARGING AND GENERATOR PANEL.

charging and generator panel recently placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., for use with these sets. The storage batteries which are used with these equipments can be charged whenever the engine is operating.

The upper part of this panel carries the terminals, voltmeter, ammeter, voltmeter, switch and generator field rheostat, the handle of which is mounted on front of the board. The lower section carries a four-pole double-throw battery switch, a generator switch, low-current cut-out (for batteries) and the necessary fuses. By means of the voltmeter switch the voltage of either half of the battery when charging, the total voltage on discharge, or the generator voltage when the main switch is closed can be read. Current can be taken from the batteries at any time or from the generator when it is running. The low-current cut-out provided prevents discharging of battery back into the generator, should the current fail after the voltage is adjusted.

Electro-Motorcycle.

The first electro-motorcycle to be introduced for practical operation is being manufactured by the Electra Cycle Company, 313 North Ashland Avenue, Chicago, Ill. This vehicle is probably the forerunner of a line of electro-motorcycles, which seem destined to enjoy an unpredecented vogue.

The speed of this electro-motorcycle is ample for all reasonable purposes, ranging from 4 to 15 and even up to a maximum of 35 miles per hour. The range of the vehicle carrying an individual of ordinary weight is easily seventy-five miles, with the lead type of battery; and with the new Edison battery of the same weight this range is increased to 150 miles on one charge.

The weight of the machine complete is approximately 200 pounds, and many gasoline motorcycles weigh more than this.

The machine has an electric motor located below the saddle and this drives the rear wheels by means of the usual sprocket and chain. The motor is specially made to run on twelve volts from the storage battery and the same current is available for a powerful searchlight mounted on the front head. There are no pedals or other motor power on the vehicle. The feet of the rider rest upon a convenient footboard located on either side of the battery case.

The electro-motorcycle is essentially a simple, safe and convenient device; but the inventor, F. E. Hatch, who is also secretary and treasurer of the manufacturing company, has made several improvements which will be incorporated in the machines sold.

One of these is a band brake, and another the means of reversing the motor, which will apply its full power in bringing the machine to a stop. The electric control only will be located in the handle, there being a small foot lever placed conveniently in the foot board for the band brake, etc. Machines will also have the coaster-brake principle incorporated so that the current can be economized on when going down grade. The stand is a new device which automatically takes care of a slanting or uneven surface in the road, so that the machine will be able to stand erect anywhere.

The battery can be conveniently charged at any garage where electric automobiles are cared for. In many cases it will be possible to connect one

or two of these motorcycles in series with an automobile battery and thereby use the entire direct-current pressure without loss in charging the batteries together, which means that the smaller battery charge will be secured at no expense.

For use in the country the machine will doubtless enable the operation of household devices, such as vacuum cleaners, washing machines, etc., on the storage battery current, as some of these devices are made with low-voltage motors.

One of the objectionable features of the gasoline motorcycles is the difficulty of starting the engine, which amounts to a serious matter in congested traffic where unavoidable stops are frequent. This difficulty is absolutely done away with in the electric machine, which starts at the twitch of a switch. There is no running half a block, or hard and undignified pedaling, required. Moreover, one does not need to be a mechanical engineer to be able to keep the electric machine in perfect order. It requires practically no more attention than a plain foot-power bicycle.

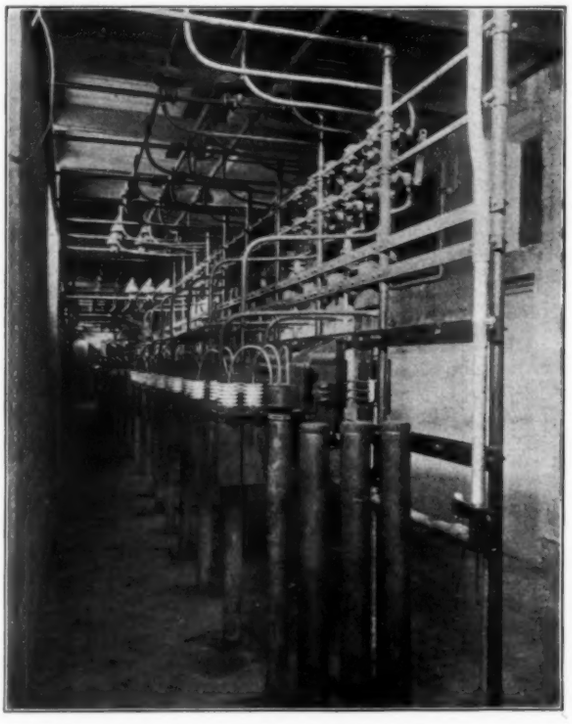
Some of the features emphasized by the inventor are: The ball-bearing motor, silent running, fifty-six-inch wheel base, cushion-spring fork, external band brake, comfortable form seat, easy resting foot board and foolproof qualities of the machine as a whole, and perhaps especially its dignified and refined appearance and action and its cleanliness and freedom from odor.

Use of High-Tension Disconnecting Switches in Station Construction.

As central-station capacities increase additional precautions must be taken to guard against accidents which will cause complete shut-downs. A practice rapidly growing in favor is to place disconnecting switches in series with the busbar side of high-tension oil circuit-breakers or switches, so that in case it becomes necessary to adjust or inspect the breaker mechanisms this can be accomplished without danger to the operator. Another useful feature is that should the oil breaker prove defective or develop short-circuits within itself the trouble can be localized by opening the disconnecting switches.

In station lightning-arrester installations the use of disconnecting switches is absolutely necessary, if it is desired to maintain the arresters in operative condition. By locating the switch between the line and arrester section a circuit can be opened and the units, being entirely disconnected, can be safely cleaned, inspected and adjusted.

Sectionalizing of high-tension busbars is also most economically effected by location of disconnecting switches in the busbar compartments. Where the busbars are carried through trenches of concrete or brickwork the switches can be secured to the floor or side walls, as desired.



INSTALLATION OF HIGH-TENSION DISCONNECTING SWITCHES.

In the particular installation shown in the illustration, made by the Delta-Star Electric Company, Chicago, Ill., the switches are mounted directly in the busbars of the heavier capacity circuits and on pipe framework for the smaller capacities. A flexibility of operation is thus secured which is very desirable and tends to increase the continuity of service by permitting instant localization of trouble. Proper use of such sectionalizing devices also insures a uniform workmanlike construction, the great importance of which is quite obvious.

Exports of Copper.

Exports of copper for the month of July were 34,955 tons, as compared with 23,018 tons last year.

Telephone Cable Lines in Germany.

The toll-line development has proceeded so rapidly in Germany during the last few years that all the important highways and most of the country roads are lined with overhead long-distance lines. The steady growth of this service has made it more and more difficult to provide for new lines so that the government telegraph and telephone administration has foreseen the need of making some radical provisions for the future. It has been decided to use henceforth as far as possible telephone cables loaded with Pupin coils. To begin with it is planned to lay a cable from Berlin to Magdeburg, which will be subsequently added to by a branch cable to Hanover. This cable will have fifty metallic circuits, which will be phantomed to provide seventy-five independent long-distance circuits.

Railway Company Buys Equipment.

The Delaware & Hudson Company, Albany, N. Y., has placed an order with the General Electric Company for one 7,500-kilowatt turbine, one 100-kilowatt turbo-exciter and four 2,500-kilovolt-ampere transformers. This apparatus will give this company an increased power supply to its extensive electric traction interests in Albany, Troy and Schenectady.

Current Electrical News

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., AUG. 1.—Great interest was taken in the recent voting on the municipal bylaw of the City of Hamilton, Ont. The Cataract Power Company and its supporters put up a big fight to defeat the bylaw to raise $504,000 for a municipal light and power plant to distribute electric energy for the hydroelectric system. The bylaw carried by a majority of 418.

There is good authority for the statement that within a few weeks the Montreal Street Railway Company will have received payment for a block of $9,000,000 five per cent thirty-year bonds, purchased by N. W. Harris & Company, the Boston, Mass., bond house. The deal regarding the purchase of these bonds has just been completed.

The Ontario Government challenges the right of the Dominion Government to the control and disposition of the water powers developed on the canals in the province, claiming that the water, before it enters and after it leaves the canal, belongs to the province, and that while in the canal it is only so far as navigation goes that the Dominion has any jurisdiction.

The fight between the town of Fort Francis, Ont., and the Ontario & Minnesota Power Company continues to be waged bitterly. The department of public works, at Ottawa, has of late been flooded with protests, declaring that the level of the Rainy River is lowered by the dams of the company, and that navigation and other interests are affected. An engineer was sent by the government to investigate.

At a special meeting of the shareholders of the Sherbrooke Railway & Power Company, of Sherbrooke, Que., the purchase of the Eastern Townships Electric Company and the Stanstead Electric Company was ratified. The acquisition of these two concerns is an important step to the Sherbrooke Company, as it thus obtains control of the major part of the electric lighting business in the thickly populated district between the town of Sherbrooke and the United States border.

W. W. Ashald, superintendent of Grand Trunk Telegraph, Montreal, has announced that the company will adopt, in the near future, the despatching of trains by telephone over the entire system of the railway, displacing the telegraph for this purpose. The entire system of the railway totals above 4,700 miles, and the telephone despatching department will include thirty circuits. The cost of installing the telephone throughout the system will be around $500,000.

The department of inland revenue, at Ottawa, has granted a license to the Western Canada Power Company for the export of 6,500 horsepower of electric energy across the international boundary at Sumas, for the purpose of carrying out a contract made by the power company with the Whatcom County Railway & Light Company, which supplies light and power to Bellingham and other towns in the State of Washington.

The power situation of the City of Montreal and district is now at a very interesting stage of development. There is likely to be serious competition before long, and a further slackening down of prices as a consequence. There is no doubt that, even when several new big power-distributing companies (now under construction) actually start to operate, the demand for the current will increase even beyond the ratio of increasing population, as many concerns are now contemplating the substitution of electric power instead of steam.

The Toronto Railway Company, at a meeting of the directors a few days ago, decided to give the stockholders a $2,000,000 stock issue at par, a stock bonus of $1,000,000 and an increase in dividend from seven to eight per cent. The stockholders, on August 14, will be asked to authorize an increase in capital stock from $8,000,000 to $12,000,000. The new stock to be issued at par will be in the proportion of one new share for every four shares held.

A great merging coup is announced from Toronto. The central figures in this huge deal are Sir William Mackenzie and R. J. Fleming, the one as financier and the other as manager. When the details are completed, these men, in the capacity mentioned, will control the following group of electric concerns: The Toronto Railway Company; the Toronto Power Company; the Electric Development Company; the Toronto Electric Light Company; the Metropolitan Railway Company; the Toronto & Scarboro Railway Company; the Mimico Electric Railway; the Toronto & Suburban Railway. In addition to this group, the projected Toronto & Eastern Railway is a Mackenzie & Mann road and is to be operated in connection with the Canadia Northern Railway System, as is also an electric line from Toronto to Niagara Falls, over the right of way of the Electric Development Company.

WESTERN CANADA.

(Special Correspondence.)

VANCOUVER, B. C., JULY 29.—Plans and specifications are announced to be in process of preparation for a new building for the British Columbia Telephone Company, at Steveston, B. C., from which a new trunk line will be constructed to Vancouver, and which will provide for the installation of an entire new switchboard and the changing from the present single wires into metallic lines.

The Vancouver Power Company, subsidiary to the British Columbia Electric Railway Company, of Vancouver, is increasing its capitalization from $2,500,000 to $4,000,000 to cover the large development schemes which are being undertaken to secure greater power for the British Columbia Electric Railway Company. One item is the construction of a tunnel between Jones and Chilliwack Lakes, for added power purposes. Another is the damming of Lake Coquitlam at the mouth, and another is the tunnel widening from Lake Buntzen to Lake Coquitlam, which has recently been completed.

The British Columbia Telephone Company, of Vancouver, is considering laying a submarine cable to Victoria on Vancouver Island, the cable to accommodate three talking circuits and thus give three times the capacity of the present long-distance cable to Victoria. It is not yet decided whether the new line will run directly across the Strait of Georgia to a point near Nanaimo at the entrance to Departure Bay or by way of the route followed by the existing cable, which proceeds via Lummi and Orcas Island, which would mean alternate stretches of land wires and submarine cables. Probably, however, the former and all submarine route will be chosen, a distance of some thirty odd miles. Manufacturers of cables might find it advantageous to watch the proposed improvements, of which particulars are not yet obtainable.

The newspapers announce the formation of the Prince Rupert Hydro-Electric Company, which is to supply the electric power and light and the gas works of the city of Prince Rupert, B. C. The president of the Western Canada Power Company, C. H. Cahan, and H. A. Lovett, both of Montreal, are said to head the Montreal interests which are securing control of the Tsimpsean Light & Power Company, the Continental Power Company, Ltd., and the water rights on the branches of the Skeena River about forty miles from Prince Rupert, which are capable of generating 25,000 to 30,000 horsepower of electrical energy. It is stated to be the intention of the new company to erect a provisional power plant to develop about 1,500 horsepower to supply the immediate demands of the locality and to proceed with the construction of a permanent installation capable of supplying 15,000 horsepower of energy, to be available about the time the Grand Trunk Pacific Railway is running into Prince Rupert. Bonds are to be issued to the amount of $2,500,000 and stock to the amount of $3,000,000, with provisions for the increase of the bonds to $3,000,000 (at five per cent) and the stock to $5,000,000, if necessary.

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEX., JULY 31, 1911.—The Mexico Northern Power Company which is constructing a great dam across the Conchos River about twenty-two miles from here for the purpose of creating a water-storage reservoir for hydroelectric and irrigation purposes expects to have the project finished by June, 1913. The construction of this dam was interfered with by the recent revolutionary troubles and for a period of several months only about 400 men were kept at work, but now that peace has been restored the number of laborers has been increased to about 1,200. The dam will form a reservoir of a capacity of 66,000,000,000 cubic feet of water. It will be thirty miles long and five to six miles wide. The hydroelectric plant will have a capacity of about 55,000 horsepower, and this electrical energy will be transmitted to Chihuahua, Parral, Jiminez, Santa Rosalia and a number of other towns and industrial centers of the state of Chihuahua. The company owns about 200,000 acres of land in the valley of the Conchos River, all of which will be brought under irrigation by means of a canal system which will derive its water supply from the big artificial lake. The cost of the works will exceed $15,000,000. J. G. McNab, a construction engineer of Mexico City, is in charge of the work. The company is composed of Canadians.

The Santa Rosa Mining Company, a subsidiary of the Exploration Company of England and Mexico, located in the State of Zacatecas, near Concepcion del Oro, has received and is erecting most of the machinery that will enter into the equipment of its mill.

Electric light and power is supplied to the property from a gas-producer plant in which anthracite coal or charcoal is used as

fuel. The gas engine will be connected by a belt to a 150-kilowatt Westinghouse alternating-current generator. Switchboards, transformers, etc., and twenty motors have been installed. The tube mill is driven by a sixty-horsepower motor; there are seven motor-driven direct-connected pumps for supplying water to the cyanide plant, and nine other motors are located at various places around the plant.

A transmission line about two miles long supplies the current to three motor-driven pumps, which control the water supply.

The Mexico Light & Power Company has completed the installation of two additional 10,000-kilowatt units in its great hydro-electric plant at Necaxa, and they are said to be giving satisfactory service. The new water-storage dam which the company is constructing will soon be finished. It and other reservoirs have been filled by the recent rains.

The Real del Monte y Pachuca Company is constructing an electric aerial tramway near Pachuca to connect its Barron mine with its Loreto reduction mill, a distance of 4,400 meters. The tramway will have a capacity of 400 tons of ore per day of ten hours. There are seventy-four steel towers ranging in height from twenty to eighty-five feet, and the longest span is 1,800 feet from point to point. There will be 125 buckets of a capacity of 800 pounds each. The rope speed will be 600 feet per minute and the ore will be delivered from the mine to the mill in about thirty minutes at a cost of fifteen cents per ton. The difference in altitude of the mine and the mill terminals is 330 feet, and the tramway crosses two divides between terminals, securing uniform speed and only needing fifteen-horsepower to take up the deficit, which is supplied from an electric motor placed at the mill. D.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The New York Edison Company, on August 3, filed with the Public Service Commission, First District, a petition asking for a rehearing in the case of the Long Acre Electric Light & Power Company, in which a majority of the Commission recently decided that the Long Acre Company should be allowed to issue $2,000,000 in stock and $4,000,000 in bonds under certain conditions.

In the petition several reasons are advanced as grounds for the request for a rehearing. It is stated that a majority opinion of the Commission finds "that no evidence was offered subsequent to December 1, 1910, before the Commission which changed the state of facts from that which existed at the time of the appeal to the Appellate Division." The Edison Company asserts that a great deal of testimony which materially changed the state of facts was offered subsequent to December 1, 1910. The Edison Company contends that the majority opinion omitted to consider such facts and that unless they are considered and given full force and effect, the Edison Company will be seriously injured, and that the failure to consider them is sufficient warrant for asking a rehearing.

The petition asserts that the order giving the Long Acre Company the right to issue stock and bonds contains no findings of fact or conclusions of law and therefore the Edison Company "deems it necessary and advisable that specific findings be made by the Commission so that they may be reviewed in connection with the evidence by the Appellate Division of the Supreme Court." It is declared that the majority opinion is erroneous because it does not consider the facts placed before the Commission and is also contrary to law, and the order of the Commission contrary to facts and law.

It is alleged by the petitioner that there is no public necessity for a competing company in Manhattan and Branx; that the Edison Company recently reduced the price of electricity to consumers; that no complaints have been made to the Commission that its charges have been unreasonable and unjust; that it is subject to rigorous regulation, has made a large investment in the County of New York which should be protected, and "unless the order of the Commission is reconsidered, its loss caused by duplication of investment will be large, and it will suffer serious loss because of its investment in the Consolidated Telegraph & Electrical Subway Company, which company would be compelled to expend a large sum of money for the accommodation of the Long Acre Electric Light & Power Company without any prospect that the investment would be productive for any length of time whatever."

The petition is signed by J. W. Lieb, Jr., third vice-president of the New York Edison Company.

The Long Acre Electric Light & Power Company's case has been before the Commission for some time. The original application asked for authority to issue $10,000,000 of preferred stock and $50,000,000 of bonds. After hearings, the Public Service Commission denied the application. The Long Acre Company appealed to the courts and the action of the commission was reviewed by the Appellate Division on a writ of certiorari. The Appellate Division decided against the Commission and sent the case back for reconsideration. Following the court mandate, the Commission held another series of hearings before Commissioner Milo R. Maltbie, who conducted the hearings on the original application and who wrote the opinion denying it. At the new hearings, the New York Edison Company appeared in opposition to the granting of the application and objected thereto for several reasons, among which were the allegations that the Long Acre Company had not actually exercised its franchise; that neither it nor his predecessors complied with the statute known as the Subway Acts and one other statute; that they did not conform to the rules of the Board of Electrical Control; that they never obtained permits from the city departments for the erection of poles, lamps and wires; that they did not comply with the provisions of the Public Service Commission Law, that they did not show a public necessity for a competing electric light and power company, and that if the Long Acre application were granted, the Commission, contrary to the statutes "would approve of a competing electric light and power company and thereby sanction wasteful and useless competition, which is against the spirit and intent of the statute under which the Public Service Commission was created."

COMMISSION NEWS FROM OHIO.

(Special Correspondence.)

The first hearing before the new State Utilities Commission of Ohio, which was recently held, involved legal propositions of vital interest to telephone companies doing business in Ohio. The complaint was filed by the Gratiot & Brownsville Telephone Company against the Brownsville Farmer's Telephone Company to prevent the latter, which is a new concern, from starting business, on the ground that an additional telephone company is unnecessary in the territory invaded. The latter company purchased a supply of equipment, including switchboard, wires and poles, before the utilities bill became a law, but work was delayed on the installation until after it became effective. The first question to be determined is whether it had proceeded far enough under its charter before the law was passed, nad, second, whether it is necessary. Upon the latter proposition the new company charges that the old service is poor and that repairs are unreasonably delayed. The case was taken under advisement and the outcome will be watched with unusual interest. H.

LIGHTING AND POWER.

(Special Correspondence.)

RANDOM LAKE, WIS.—It has been voted to install an electric light system. C.

FAIRVIEW, S. D.—A. G. Pond is planning the construction of a power plant. C.

ROLAND, IOWA.—The Commercial Club is agitating the installation of electroliers. C.

AITKIN, MINN.—M. D. Stoner is planning to supply the village with electric light. C.

COLTON, CAL.—The Edison Electric Company is to build a new power house in this place.

STOCKDALE, TEX.—The Farmers' Gin Company is installing an electric light light plant here. D.

NEWBURG, MO.—W. N. Schwalbe and E. Sprague have been granted an electric light franchise.

GLOBE, ARIZ.—An electric power plant is to be installed at the Copper Reef mines near this city.

FARGO, N. D.—City Engineer Anders has completed plans for the installation of an electric light plant. C.

SACRAMENTO, CAL.—The Citizens' Light & Power Company has been incorporated with capital of $5,000,000.

CASCADE, MONT.—The Great Falls electric properties will supply current for lighting and power in this city. C.

BROWNS VALLEY, MINN.—Bonds for $10,000 for the construction of an electric light plant have been voted. C.

FORT DODGE, IOWA.—A bond issue of $125,000 has been voted for the construction of a hydroelectric plant.

MINDEN, NEB.—Bonds to the amount of $15,000 have been voted for the construction of an electric light plant.

FERGUS FALLS, MINN.—The city engineer will soon prepare plans for the proposed Way of Light on Lincoln Avenue. C.

SALT LAKE CITY, UTAH.—Herbert Seaboldt will erect a power plant on the Colorado River, near the Cataract Canyon. A.

SUMAS, WASH.—The British Columbia Electric Company is to install an electric power and light system in the town of Sumas.

ALBUQUERQUE, N. M.—The Tucumcari Light & Power Company has been incorporated with a capital stock of $100,000.

NEW BRAUNFELS, TEX.—Bonds to the amount of $67,000 have been voted for the construction of a hydroelectric plant.

ENGLEWOOD, KAS.—This city has sold $20,000 worth of bonds and will install an electric light and waterworks plant.

DES MOINES, IOWA.—The State Fair Board has provided for the installation of 250 200-candlepower tungsten lights at the state fair. C.

DULUTH, MINN.—Municipal ownership of the electric light plant is being actively agitated by the Central Hillside Improvement Club. C.

MINNEOTA, MINN.—The Village Council has granted a franchise to J. H. Jonathan for the installation of an electric light plant. C.

ST. PAUL.—The city administration favors the installation of a street lighting equipment, for which the sum of $75,000 has been appropriated. C.

CENTRAL CITY, IOWA.—Work has been commenced on the

construction of a concrete dam for the electric light and power plant. C.

CHICO, CAL.—The Board of Trustees is figuring on the cost of installation of an electrolier street lighting system in the business section. A.

KENNET, CAL.—The Sacramento Valley Power Company has applied for an electric power and light franchise in the town of Kennet

ST. PETER, MINN.—The Committee on Electric Lights has been authorized to purchase a large condenser for the engine at the power house. C.

ELLENSBURG, WASH.—A special election has been called to decide upon the $100,000 bond issue recommended for the municipal lighting system.

ALTAR, SONORA, MEX.—The Las Palomas Mining Company is planning for the erection of a new power plant fourteen miles from its property. A.

CORNING, IOWA.—At an election which was held here recently the proposition of a municipally operated plant was defeated by a large majority.

CONCORD, CAL.—A fifty-year franchise for a transmission line in the town of Concord has been granted to the Great Western Power Company.

ROCHESTER, MINN.—The contract for the installation of the cluster lighting system on Broadway has been let to W. O. Hartig, of Minneapolis, at $8,661. C.

FRESNO, CAL.—The San Joaquin Light & Power Company will construct a power line to Dos Palos, Los Banos and Gustine. Surveys have been made. A.

GRASS VALLEY, CAL.—The Delhi mine contemplates the erection of an electric power plant. St. Gothard Consolidated Gold Mining Company, owners. A.

PERRIS, CAL.—N. L. Graham, representing F. A. Worthley, has made application for a fifty-year franchise for a light and power system in this town.

TROPICO, CAL.—The city trustees have instructed the city engineer to prepare plans and specifications, and estimate cost, for a new street lighting system. A.

FORT JONES, CAL.—The power station of the Siskiyou Electric Company, at Indian Creek, near here, was struck by lightning and destroyed. Loss about $6,000. A.

COLUSA, CAL.—The Northern California Power Company has made application for a franchise for a transmission line along the public roads of Colusa County.

DULUTH, MINN.—There is an agitation by the West End Commercial Club for the installation of a White Way on Superior Street, at an estimated cost of $3,500. C.

GUANAJUATO, MEX.—The Guanajuata Electric & Power Company is planning to extend its power line to the Ave de Gracia mining district, a distance of fifteen miles. A.

NORTH FREEDOM, WIS.—O. Nelson, of Beloit, and Arthur Voeck are planning extensive improvements to the electric light plant which they purchased of John Voeck. C.

PRINCETON, IND.—Steps are being taken by the City Council to install a system of cluster lights around the public square and throughout the business portion of the city. S.

SALINAS, CAL.—The Monterey Gas & Electric Company has made application for a fifty-year franchise for a transmission line along all public roads of Monterey County.

OLYMPIA, WASH.—Bids will be received by the State Board of Control for the installation of a complete power plant at the Washington Veterans' Home at Fort Orchard.

LOS ANGELES, CAL.—The Pacific Light & Power Company will install a new transmission system in connection with the enlargement of its San Gabriel Canyon power plant. A.

WATTS, CAL.—The Board of Supervisors has made a five-year contract with the Pacific Light & Power Company to furnish the town of Watts with electricity for light and power.

BREMERTON, WASH.—The Bremerton-Charleston Light & Fuel Company has applied for a franchise for an electric transmission line along the county roads of Bremerton.

TUCSON, ARIZ.—Engineers are now at work on a large power plant near Noria, Ariz., which will furnish power to the town of Llano and to four mines and smelters near there.

HOOD RIVER, ORE.—A complete power and generating plant will be erected in conjunction with the hotel and sanitarium to be built by the Hood River Mineral Springs Company. A.

VISALIA, CAL.—The Mt. Whitney Power & Electric Company will build a new power plant on West Main Street. Contract for the building has been awarded to Trewhitt & Shields. A.

SHAVER, CAL.—The Pacific Light & Power Company, of Los Angeles, will build a new hydroelectric plant at Big Creek, near here. G. O. Newman is chief engineer of the company. A.

VIVIAN, LA.—The Vivian Ice, Light & Water Company was recently incorporated with a capital of $50,000. The incorporators are O. C. Jacobs, president, and J. D. Wilkinson, secretary.

PORTLAND, ORE.—The Mount Hood Railway & Power Company will install a lighting system in connection with its artificial lake on the divide between the Sandy and Bull Run Rivers. A.

MARTINSVILLE, IND.—The City Council appropriated $7,000 for the installation of an ornamental street-lighting system and will receive bids for the modern type of posts and lamps. S.

FORT MASON, CAL.—Col. George McK. Williamson, U. S. Government, is asking for bids for the installation of a lighting system at Fort Miley, San Francisco. Estimated cost $25,000. A.

SAN BERNARDINO, CAL.—The California-Nevada Power Company has been awarded a franchise for an electric transmission line through San Bernardino County. Work will start at once.

REDDING, CAL.—The Northern California Power Company, it is said, will replace its aluminum power lines with copper wire, owing to the damaging effect of smelter fumes upon the former. A.

EL CENTRO, CAL.—The Holten Power Company has increased its capital stock from $500,000 to $1,000,000. The capacity of its power plant will be increased, and extensions made in transmission system. A.

MARYSVILLE, CAL.—The Pennsylvania mine, Browns Valley, near here, will abolish its oil burning equipment and install electrical machinery for operation. J. C. Campbell is owner of this property. A.

SUNMAN, IND.—The electric light plant erected in this city by Joseph M. Kuebel, has beeen put in operation. Mr. Kuebel has a twenty-five year franchise and a contract for several hundred street lights. S.

PT. ANGELES, WASH.—P. J. Woods of this city has been awarded an $18,000 contract by the Olympic Power Company for preparing the right of way for a transmission line from this city to Irondale.

INDIANAPOLIS, IND.—The property of the telephone companies in Indiana has been appraised for taxation by the State Tax Board at $12,317,536—an increase of $1,107,704 over the valuation for 1910. S.

KEOKUK, IOWA.—The public utilities of this city have been sold to the Stone & Webster Engineering Corporation, Boston, who will expend several hundred thousand dollars in construction and improvement. C.

RIVERSIDE, CAL.—Fred Mechlin has been granted a franchise for a transmission system in this county; $150 was paid for same. A company will be organized to develop and furnish power to industrial plants. A.

DOUGLAS, ARIZ.—The new transmission lines of the Copper Queen Mining Company plant from here to the Tigre mining district, Sonora, Mex., a distance of seventy-two miles, have been completed and placed in service. A.

LOS ANGELES, CAL.—The California Consolidated Light & Power Company, of Salinas, Cal., has been incorporated by C. S. Chauncey, S. Goodrich, J. T. Pigott, T. E. Palmer, Grove O'Conner and G. R. Ray for $5,000,000.

LOS ANGELES, CAL.—The Board of Supervisors has granted the city a franchise for five years for a power line from the Southern California Edison Company plant, near San Fernando, to a point on the municipal aqueduct. A.

SAN FRANCISCO, CAL.—Plans are being made by the Pacific Gas & Electric Company for improvements of its system that will cost about $10,000,000. The plans include the erection of a large dam in the South Yuba River.

SACRAMENTO, CAL.—The Southern Sierra Power Company, Cheyenne, Wyo., has filed articles of incorporation with a capital of $5,000,000. Delos A. Chappell (president California-Nevada Power Company), L. C. Phipps, and C. F. Potter, incorporators. A.

FRESNO, CAL.—The San Joaquin Light & Power Company has completed its 60,000-volt transmission line from its power house at South Fork, on the San Joaquin River, to Coalinga. A new substation is being erected near King River bridge, Coalinga.

MASCOUTAH, ILL.—The City Council has passed an ordinance providing for a bond issue of $12,000, the money to be used either for purchasing the plant of the Mascoutah Electric Light Company or building a municipal plant. Confirmation by the voters is necessary. Z.

MENASHA, WIS.—The Council has let the contract for the Deisel Engine Company for a 225-horsepower engine and to the Wagner Electric Company for a 200-kilovolt-ampere generator and switchboard at the light plant, to cost $15,200 and $2,900 respectively. C.

OAKTOWN, IND.—The Oaktown Gas & Electric Company is the name of a new corporation that is proposing to construct and equip a gas and electric plant in Oaktown. W. J. Walker, John F. Stoelting, Theadore E. Salter, W. B. Bratton and M. R. Palk directors. S.

QUINCY, ILL.—A permanent association for the purpose of increasing the number of ornamental lights in the city will be formed. The organization is the outgrowth of the campaign by the Retail Merchants' Association, Civic Improvement League and the Chamber of Commerce. Z.

PORTERVILLE, CAL.—The Co-operative Electrical Power Com-

pany, formerly the Tulare County Power Company, is planning for the erection of its auxiliary power plant here. The company will build a railway between this place and Lindsay, on the north, and to Tulare, on the west. A.

CLINTON, IND.—The Clinton Electric Light & Power Company has notified the Secretary of State of an increase of capital stock from $10,000 to $40,000. It is understood the company is preparing to make extensive improvements and install some new machinery and apparatus. S.

NEW SHARON, IA.—A deal is pending which may result in the Oskaloosa Traction & Light plant taking over the local electric light plant and running current to this city from the county seat. There would be an advantage to New Sharon in such an arrangement by securing a twenty-four hour service.

GOLDENDALE, WASH.—The Northwestern Electric Company has advertised for bids on the $100,000 dam which is to be constructed at the power site, on the Big Klickitat River, between this city and Lyle. The company will build a $500,000 electric plant, using the power for railway development and municipal purposes.

TOWER, MINN.—The City Council recently opened bids for the construction of a hydroelectric plant at Pike River Falls, to replace the present steam power plant owned by the city. The city has voted bonds for 16,000 for the purpose. There is a strong probability that the council will advertise for another set of bids.

HONOLULU, T. H.—A franchise for an electric lighting and power system for the towns of Wailuku and Kahului, T. H., has been granted to Hon. H. P. Baldwin, B. A. Wadsworth, J. N. S. Williams, D. C. Lindsey, C. D. Lufkin, James L. Coke and W. T. Robinson. The plant will be situated midway between these two towns.

VALLEJO, CAL.—The local merchants' association at a meeting recently endorsed the project of lighting four blocks of Georgia Street, the main business thoroughfare, with strings of incandescent lights across the street, these lights to be turned on Saturday evenings and the nights of the weekly pay-day at the Mare Island navy yard.

NESS CITY, KAN.—At a meeting of the City Council here recently, an ordinance was passed providing for the calling of a special election to vote upon the proposition of issuing bonds for the purpose of building an electric light plant here. The proposition is to vote bonds in the sum of $16,000, payable in twenty years at five per cent.

RIVERSIDE, CAL.—The Southern Sierra Power Company, recently incorporated at Sacramento, has been granted a franchise in this, and San Bernardino counties, through F. A. Worthley. A steam generating plant of 5,000-kilowatts capacity will be built at San Bernardino, and a transmission system erected. Offices will be maintained at Riverside. A.

PLANKINTON, WIS.—The City Council of this place has granted to W. A. Kuntz a twenty-year franchise for operating an electric-light system. The city reserves the right to purchase the system at any time after the expiration of ten years. According to the terms of the franchise the system must be completed and in operation by January 1, next.

MT. VICTORY, O.—The Mt. Victory Bank Company has purchased, at bankruptcy sale, the electric plants which formerly supplied light to Mt. Victory and Ridgeway. The price paid was $3,000. The plant has been closed for several months and the towns have been in darkness. It is the intention to form a new company and again furnish light for these communities. H.

BROCKTON, MASS.—The Brockton Electric Light Company has presented a petition to install poles and necessary equipment for putting electric lights into this town. The matter has been agitated for some time, being brought to a head by a petition circulated among the leading business men for a franchise to be granted some electrical concern to install the power.

OROVILLE, CAL.—It is officially stated that the large dam being built by the Great Western Power Company will be completed by January, 1913, and the company will then put up three additional plants, one on the Feather River at Butte Creek, one on Mosquito Creek and the third at Bartlett's Bar, which will represent an investment of $15,000,000 to $20,000,000.

LOS ANGELES, CAL.—The Board of Supervisors has issued instructions for the installation of a power line from the Eastlake substation, Los Angeles, of the Pacific Light & Power Company to the County Hospital. This is to utilize the fifty-horsepower per year due the county by the corporation on its franchise. The county purchasing agent will be in charge of the work. A.

LINTON, IND.—The Indiana Steel & Iron Company, recently incorporated with a capital of $100,000, proposes to construct an electric plant for supplying current for light and power for its works to be built in Linston. William J. Hamilton, of Linton, is the resident member and the men back of the big enterprise are Marcus K. Frank, J. D. Karrsik, A. A. Granville and S. R. Sobel, of Pittsburg, Pa. S.

BEDFORD, IND.—A company represented by James R. Goodrich, of Winchester, has bought the electric light plant at Mitchell, one of the conditions of the sale being that the purchasers are to install an up-to-date system of water works. Mitchell is perhaps the only city of its size and importance in the state without water works and the fire loss to the town during the last year from lack of fire protection would more than have paid for a first-class water plant. Work will begin immediately.

FORT COLLINS, COLO.—With a view of erecting a hydroelectric plant on the Poudre River to supply Fort Collins and other cities of Larimer County with light and power, the City of Fort Collins will file on a power-plant site, thirty-three miles west of town. The proposed plant will be located at the head of the "Big Narrows," on the Poudre River. The proposition to float a $150,000 bond issue will be placed before the people and, if the issue is approved, the city will build a big enough plant for a city of 25,000.

CENTRAL CITY, IA.—Work was begun on the concrete dam for the electric light and power plant to be erected in this city this fall. Machinery for the plant will be shipped soon. The heavy machinery will all be placed in position first and then the work of erecting the building will be rapidly pushed to completion. Several carloads of poles for lines have arrived in the city, and a large force of men will be kept busy placing the same in the streets and along the public highway between Central City and Center Point.

AUSTIN, TEX.—The proposition of William D. Johnson, of Hartford, Conn., head of the Hydraulic Properties Company of New York, for the construction of a dam across the Colorado River at Austin and the installation of a hydroelectric plant will be voted on by the people of the city on August 30. Mr. Johnson has deposited $25,000 to the credit of the city as a guarantee that he will build the dam and hydroelectric plant in accordance with the contract and specifications as agreed upon by him and the City Commissioners. The proposed cost is $1,600,000. D.

NORIA, MEXICO.—H. A. Smith has prepared plans for the construction of a large dam across a deep canyon near here and the installation of a hydroelectric plant. This plant will have a capacity of about 1,000-horsepower and the electrical energy will be transmitted to the mines and smelters in that section, including those of the Calumet & Sonora Copper Company, the Llano Consolidated Copper Company, the Sonora Copper Company and the Cobriza Copper Company. The dam will be 150 feet high and from 15 to 100 feet wide. Besides providing power for the hydroelectric plant it will give a water supply for irrigating about 15,000 acres of land. D.

BEAUMONT, TEX.—The Stone & Webster Engineering corportion of Boston, Mass., has obtained an option to purchase all of the holdings of the Beaumont Ice, Light & Refrigerating Company with the exception of its ice and refrigerating plant. The property involved in the pending transaction is the local electric light system and power plant. It is stated that these will form a nucleus for an extensive system of electric railways in that city and an interurban railway to run between here and Port Arthur, twenty-five miles. The option runs until October 3. Representatives of the Stone & Webster Engineering corporation have just made a complete inspection of the property and will report on same. D.

WALTHAM, MASS.—L. B. Dow, a constructing engineer of Boston, is constructing for the Clarendon Power Company an electric lighting and power plant at Clarendon, Vt., at an estimated cost of $550,000 which is planned to compete with the Rutland Railway, Light & Power Company in supplying the near-by city of Rutland with electricity for lighting and power purposes. The company expects to send electricity into Rutland by January 1 and proposes to give that city electricity for lighting and power for half the rates now charged by the old company. The new company controls nearly four hundred acres of land along Mill river in Clarendon and will build a dam sixty-eight feet high ad 100 feet long at Clarendon gorge, wh.ch will flood thirty-five acres of land. The company expects to generate 6,000 horsepower. The company is capitalized at $500,000 with $250,000 already subscribed.

SOUTH BEND, IND.—The Michigan & Indiana Electric Company is preparing to make changes to its East Colfax Avenue power plant in this city in order to take care of the increased demand for power. It is planned by the company to install an entirely new set of boilers with a capacity as great as those now in use, in a new boiler room, work on which has already commenced. This will be the second addition to the plant in the last year, the entire building housing the machinery having been rebuilt. A new sidetrack permit has just been granted by the City Council, which will facilitate the handling of coal for the plant. The local power plant is furnishing more electrical energy than ever before, and to this is ascribed the necessity for enlarging the capacity of the plant. W. G. Fargo, consulting engineer, of Jackson, Mich., has been employed by the Michigan & Indiana Electric Company as engineer in the construction of a dam at Elkhart, Ind. The company will do its own work. The cost of the dam will be about $250,000 and the hydroelectric plant will generate 3,000-horsepower. The work will begin in a short time and will require a year for completion. Plans are being prepared for a large modern power house at that point, which when completed will be one of the best equipped and largest in Indiana. Only the preliminary work will be done this year. The combined steam and water power will generate 7,500-horsepower.

ELECTRIC RAILWAYS.

(Special Correspondence.)

PORTERVILLE, CAL.—The Porterville Northeastern Railway will build a new power plant. A.

SAGINAW, MICH.—The Pere Marquette Railway appropriated $75,000 for a new power house here.

CALWA, CAL.—The Fresno, Hanford & Summit Lake Railroad, it is said, will build a branch here. A.

KOKOMO, IND.—Construction work has begun on the traction line between Kokomo and Frankfort.

WATERLOO, IOWA.—Grading on the Waterloo-Oskaloosa Interurban line will be commenced August 10. C.

DULUTH, MINN.—The council has been petitioned to order the extension of the street car line to Sixty-third avenue. C.

LODI, CAL.—The Southern Pacific Railroad is said to be planning for the construction of an electric road from this city to Antioch. A.

PORTLAND, CAL.—Plans are well under way for the erection of large car barns for the Portland Railway, Light & Power Company.

PORTLAND, ORE.—The Beaumont Land Company has been granted a permit to construct an electric railway in certain districts. A.

SACRAMENTO, CAL.—The California Central Traction Company is planning for extensions in its system in this city and at Stockton. A.

ISSAQUAH, WASH.—The Anderson Steamboat Company is planning for the installation of an interurban railway to serve Leschi Park. A.

CHICO, CAL.—The Northern Electric Railway is planning to install a standard gauge line here. A franchise has been asked for that purpose. A.

EUREKA, UTAH.—A franchise has been granted to Jackson McCrystal for an electric railway between this place, Mammoth and Silver City. A.

DULUTH, MINN.—The Duluth Street Railway Company has commenced relaying its tracks on Grand avenue with ninety-one-pound steel rails. C.

REDWOOD CITY, CAL.—A franchise has been granted to Judge Fitzgerald for the construction of an electric railway between this city and Woodside. A.

WOODLAND, CAL.—The Sacramento Valley Westside Electric Railway has let the contract for the survey of its proposed road to Engineer W. B. Dozier. A.

HILLSBORO, ILL.—Surveys have begun for the line from this city to Taylor Springs. The road will be financed by the Hillsboro Electric Light & Power Company. Z.

SAN DIEGO, CAL.—The San Diego Electric Railway has been granted a forty-two-year franchise for $60,000. The grant provides for a two-per cent gross income tax. A.

ABERDEEN, WASH.—The Federal Light & Traction Company, New York, is considering the extension of the electric service of the Gray's Harbor Railway & Light Company. C.

BERKELEY, CAL.—A franchise has been granted the Oakland Traction Company to construct double or single track street railroads along certain streets of the City of Berkeley.

PORTLAND, ORE.—A new terminal station, costing $45,000, is being built by the Mount Hood Railway & Power Company between Vancouver and Williams Avenues, Portland.

SAN FRANCISCO, CAL.—Through a $2,000,000 bond deal recently closed in New York the extension of the Oakland & Antioch Railroad into Oakland and Stockton is now assured.

SEBASTOPOL, CAL.—The Petaluma & Santa Rosa Railway Company has been granted a fifty-year franchise for a standard-gauge electric railway line in the town of Sebastopol, Cal.

MARYSVILLE, CAL.—Within the next few months the Northern Electric Railway Company is to make extensive improvements in its system in this town. New car barns and a new passenger station will be built.

MOUNT VERNON, WASH.—The Bellingham & Skagit Interurban Railway has acquired a right of way for its proposed line into this city from Bellingham, twenty-two miles. This is a Stone & Webster property. A.

INDIANAPOLIS, IND.—The State Board of Tax Commissioners has certified the appraisement of electric railway property in Indiana at $23,383,012—an increase over the appraisment for the year 1910 of $1,006,774. S.

AUSTIN, TEX.—The Austin Electric Railway Company announces that it will extend its line to the site of the proposed dam across the Colorado River about three miles west of this city. W. J. Jones is president. D.

SANTA ROSA, CAL.—Construction work will begin at once on the Santa Rosa end of the Santa Rosa-Clear Lake Railroad. J. W. Barrows, who has been with the Western Pacific Railroad, will have charge of the work.

WABASH, IND.—An electric line is to be built from Garrett to Wawasee, and thence to Milford. This will give trolley connection to South Bend, Ft. Wayne and Indianapolis from Wawasee, the popular summer resort.

LAURENS, S. C.—It is understood here, on good authority, that the interurban trolley company, which is building a line from Greenwood to Charlotte, is again considering the advisability of running its line to Laurens.

SANTA MONICA, CAL.—The Pacific Electric Railway has been granted a forty-year franchise on Eighth Street. The company contemplates improvements and extensions here, including depot and carbarns, to cost $150,000.

EVANSVILLE, IND.—The annual report of the Rockport and Mt. Vernon electric lines, which are operated by the same company, shows that the gross earnings of the two roads were $192,786.23 and the net earnings $88,345.67. S.

RED BLUFF, CAL.—The four counties of Yolo, Glen, Colusa and Tehama have raised the sum necessary for the preliminary survey for an electric railway from Woodland to Red Bluff, and this work will be begun at once.

HOOD RIVER, ORE.—Articles of incorporation of the Hood River Terminal Company have been filed. This company has been incorporated by W. A. Delashmutt, A. B. Ireland and W. Chapman with a capital stock of $5,000.

BELLINGHAM, WASH.—A company has been incorporated by former governor A. E. Head, with a capital of $25,500,000, to construct the Mount Baker & Spokane Interurban Railroad, 500 miles long, from Puget Sound to Spokane. C.

LOS ANGELES, CAL.—The Pasadena Rapid Transit Company, incorporated for $3,000,000 sometime ago, announces that it has secured a right of way between this city and Pasadena, and will soon commence construction of a line. A.

TERRE HAUTE, IND.—Because of a number of accidents, some of which were fatal, the City Council has passed an ordinance over the mayor's veto, requiring all street cars operated in Terre Haute to be equipped with air brakes. S.

VINCENNES, IND.—The Vincennes, Washington & Eastern Traction Company, which is building an electric line from Vincennes westward, has filed deeds for the rights-of-way with the Recorder. The construction of the grade is progressing rapidly. S.

WOODLAND, CAL.—The Sacramento & Woodland Electric Railway has filed formal articles of incorporation with a capital of $1,000,000. T. T. C. Gregory and William Pierce, Suisun, Cal., and C. J. Goodsell and G. A. Posey, San Francisco, are the incorporators. A.

MARTINEZ, CAL.—The Oakland & Antioch Electric Railway has awarded a contract for the construction of a tunnel one mile in length through the hills between Contra Costa and Alameda Counties. This road will be extended from Bay Point to Stockton. A.

FORT WORTH, TEX.—The formal merger of the lines of the Citizens' Railway Company of Fort Worth into the system of the North Texas Traction Company has taken place. The acquired holdings will be improved and extensions made to the enlarged system. D.

PHOENIX, ARIZ.—The Salt River Valley Electric Railway has been incorporated by F. M. Winter, W. S. Furman and others. Lines will be constructed from this city to Peoria, fifteen miles; to Scottsdale, eleven miles; to Mesa, eighteen miles. The estimated cost is $600,000 A.

BELLINGHAM, WASH.—The Bellingham, Mount Baker & Spokane Interurban Railway has been incorporated with a capital of $22,500,000, by A. E. Mead, a former governor. A road is to be constructed from this place to Spokane, 288 miles, at an estimated cost of $20,000,000. A.

AUSTIN, TEX.—The South Austin Street Car Company has been organized with a capital stock of $25,000. It is constructing an electric railway line in South Austin. Incorporators are J. H. Green, F. H. Faust, T. M. West, C. V. Birkhead, San Antonio, and E. B. Birkhead, Dallas. D.

VERSAILLES, IND.—A survey has been completed and nearly all the right-of-way secured for an electric line from Versailles to Osgood. The estimated cost of the road is $250,000. L. H. Philips, of Clinton, Mo., and J. E. Wayland, of Girard, Kansas, are backing the enterprise. S.

SAN JOSE, CAL.—Bids for the sale of the franchise of the San Jose & Santa Clara Railroad Company on Alameda and North Fourteenth streets and that of the San Jose Railroad Company's Willow and Delmas Streets lines, which have expired, will be opened on September 5, 1911.

KOKOMO, IND.—The Kokomo & Frankfort Traction Company has begun construction on its line between Kokomo and Frankfort. The Company has agreed to enter the city of Frankfort by way of the City Park and the city has agreed to secure the right of way over that route, thus settling a very perplexing situation. S.

DES MOINES, IOWA.—The Des Moines City Railway Company, of which J. R. Harrigan is general manager, will expend about $70,000 on an addition to the car barns at Twenty-fourth

Street; heavier rails on the Highland Park line; new low-pressure turbines at the power plant; 500 and 300-watt rotary convertors, etc. C.

SOUTH ROYALSTON, MASS.—A survey has been made for a proposed electric railroad between Athol and Winchendon, along the north side of Millers River, via South Royalston, Lake Dennison and Baldwinville. Should this proposition materialize, it would form a much needed connection between Athol and Winchendon and might form a part of a trunk line from Greenfield to Boston.

STOCKTON, CAL.—The officers of the company announce that the Tidewater & Southern Electric Railway, being built between Stockton and Turlock via Modesto, will begin operations in October. It is further announced that this company is negotiating for a lease of the Western Pacific track from Ortega to the water front at Stockton. Work on the steel bridge of the Tidewater & Southern Electric Railway is well under way.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has purchased of the General Electric Company two 300-kilowatt rotary converters, fifteen 300-kilovolt-ampere transformers and a switchboard. The rotary converters and six of the transformers are to be installed in the Maywood substation and six in the Mooresville sub-station. The switchboard will be installed at the Maywood sub-stantion. S.

WILMINGTON, DEL.—It is understood that plans have been made and estimates secured for an electric railway line along the Delaware River to connect the system of the Wilmington & Philadelphia Traction Company with the New Castle & Delaware City line at New Castle. It is also reported that there is a probability of the project being carried out in case the Delaware City road is not purchased by the Wilmington & Southern Traction Company.

BOISE, IDA.—Boise, Nampa and Caldwell, within the present year, will be the three corners in a perfect triangle of electric roads, two sides of which are already constructed and in actual operation and the third to be built this year parallel to the Oregon Short Line connecting the two cities of Caldwell and Nampa. There is lively bidding for the construction of the latter link and a question as to which of the three bidders in the field will be successful.

LEAGUE CITY, TEX.—The large power house at League City of the Galveston-Houston Interurban Railawy Company is finished and the machinery has been given a successful tryout. The construction of the line between Houston and Galveston is well advanced and will be finished before the causeway across Galveston Bay is completed. The line will not be opened until this causeway is finished, as the company will obtain its entrance to Galveston over that structure. D.

TIFFIN, O.—The Tiffin Commercial Club and the Fremont Board of Trade will co-operate with Carl C. Anderson, A. H. Jackson, of Fremont, and A. S. Close, of Toledo, in a plan to connect Fremont and Tiffin with an interurban line. Promoters are now securing the right of way, and work will be started within four months and completed within a year. The old Bunn route, nearly all of which was graded six years ago, will be followed. About fourteen miles of line will be required. H.

COLUMBUS, O.—The Ohio Tax Commission has raised the tax valuations of electric railways in this state in many cases from 300 to 1,000 per cent. Officials of various roads announce that they will protest against the action which they characterize as absurd in many instances. The biggest change made was that in the valuation of the Northern Ohio Traction Company, which was increased from $1,594,337 to $11,272,100. The Toledo Railways & Light Company met with a proportionate raise. H.

DALLAS, TEX.—J. F. Strickland, president of the Southern Traction Company, says that satisfactory progress is being made in the preliminary work for the construction of an interurban electric railway between Dallas, Waco and Corsicana. The different towns along the proposed routes have secured the right of way and complied with other conditions for the building of the line. There are still a few details to be arranged, whereupon the contract for the construction of the road will be let. D.

TIOGA, TEX.—The Commercial Club of Tioga is promoting the construction of an interurban electric railway to run from McKinney to Gainesville, a distance of about fifty miles. The route of the proposed road is via Weston, Celina and Pilot Point to Tioga by Burn City, through a section of agricultural territory that is in a high state of development and very densely populated. The proposition is meeting with favor by the towns and people along the route and a company to carry out the project will soon be organized. D.

SPRINGFIELD, ILL.—The Springfield & Northwestern Interurban Railway Company plans to build the first division of its line from Springfield to Petersburg through Andrew, Cantrall, Athens, Tice, Old Salem Chautauqua and Petersburg. Later a branch will be built to Mason City by way of Greenview. The board of directors elected is as follows: Homer J. Tice, Greenview; R. Y. Kincaid, Athens; E. D. Keys, Springfield; W. F. Workman, Springfield; Ralph N. Baker, Springfield; Frank Reisch, Jr., Springfield, and S. E. Pratner, Springfield. The men interested in the project are among the leading bankers and financial men of Central Illiinois. Surveys already have been made. Z.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

NAPA, CAL.—W. M. Lyons has been granted a fifty-year franchise for a telephone line in Napa County, Cal.

BOERNE, TEX.—The Kendall County Telephone Company has been incorporated with a capital stock of $10,000.

COUNCIL BLUFFS, IOWA.—Excavating has been started for the addition to the telephone building on Scott Street. C.

FARGO, N. D.—The Northwestern Telephone Exchange Company is planning extensive improvements at this point.

RENO, NEV.—The Home Telephone Company of San Francisco, Cal., contemplates the installation of a system here. A.

WICKENBURG, ARIZ.—The Arizona Construction Company will construct a telephone line from this city to Parker, Ariz. A.

ALBERT LEA, MINN.—The Northwestern Telephone Exchange Company will expend $10,000 putting its cables underground. C.

CEDARHOME, CAL.—The Cedarhome Telephone Company has been incorporated for $10,000 by Peter Hanson and N. Nielson.

RIVERBANK, CAL.—The Pacific States Telephone & Telegraph Company is planning for the erection of an exchange building here. A.

UNDERWOOD, CAL.—The Underwood Telephone Company of Underwood has been incorporated by J. H. Hussey, M. Smith and H. Love for $2,000.

OMAHA, NEB.—Ground has been broken for the addition to the Nebraska Telephone Company's office building on Douglas and Seventeenth Streets.

COLUSA, CAL.—The Colusa County Telephone Company will install new equipment and make improvements in its system in all parts of the city.

ST. HELENA, CAL.—W. H. Simmons has been granted a twenty-year telephone franchise in this district. Construction of a system will soon commence. A.

COVINA, CAL.—An interchange agreement has been made between the Pacific Telephone & Telegraph Company and the local Home Telephone Company, to cover this entire section. A.

SEATTLE, WASH.—The Williams Submarine Telegraph Company of Seattle has been incorporated by A. Williams, Horace P. Chapman and G. Parsons, with a capital stock of $1,000,000.

MARINETTE, WIS.—The Harmony Telephone Company, of which H. L. Reeves is manager, has been organized with a capital of $10,000 to build a line from Harmony Corners to Marinette. C.

INDEPENDENCE, ORE.—The Home Telephone Company has been acquired by C. E. Carlos, Portland. The exchange plant will be augmented by new equipment; extensions will be made in the system. A.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will expend $1,000,000 in the erection of modern fireproof exchanges here and at Wauwatosa, Beloit, Appleton and Fond du Lac. Other improvements will also be made. C.

TUCSON, ARIZ.—The Consolidated Telephone, Telegraph & Electric Company will install a new switchboard and auxiliary equipment in its local station. The system from Solomonville to Pima will be rebuilt. C. W. Hinchcliff is manager. A.

GREENSBURG, IND.—The Decatur County Telephone Company has completed and placed in operation its new automatic central exchange. This exchange system is one of the most complete and modern automatic systems in the State.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company, the Colorado Telephone Company and the Tri-State Telephone & Telegraph Company have been consolidated under the name of the Mountain States Telephone & Telegraph Company.

MASON CITY, IA.—The average development of the telephone systems among the towns and cities of Iowa is seventeen per cent, according to figures shown by a telephone company, which has just finished a commercial study of Mason City, Charles City and many other places.

SANTA FE, N. M.—The Mountain States Telephone & Telegraph Company of Denver has filed articles of incorporation with a capital of $5,000,000. The organization comprises the Tri-State Telephone & Telegraph Company and the Colorado Telephone Company; E. B. Field, Roderick Reid et al., incorporators. A.

NEWCASTLE, IND.—The Central Union Telephone Company is reported to have purchased all property, plant and franchises of the Newcastle Telephone Company, including all rural lines. Rates will be advanced about thirty per cent. The Eastern Indiana Telephone Company, of Winchester, owns the stock of the Newcastle Company. S.

SEYMOUR, ILL.—The Seymour Telephone Company stockholders, at a recent meeting, decided on a new location for the exchange. A building to be used for that purpose will be bought or land will be secured and a telephone office erected. A committee of five was elected to attend to the matter of securing a location. The committee was composed of James Karr, John White, Peter Schumacher and J. Murray.

ELECTRICAL SECURITIES.

The general trend of the market has been downward, carried on by excessive selling. In Chicago local stocks were heavy, the losses ranging from fractions of a point to several points throughout the list. Among the largest of the declines was the Chicago Elevated preferred, which sold at 90. More than 7,000 shares of United States Steel changed hands during the first hour alone, and the total for the day was about 10,000. Reading came next in point of activity, although the tractions were also largely traded in. The further break in New York affected the local list but moderately. Electric Storage Battery, Cambria Steel, Philadelphia Electric, Tonopah-Belmont, United Gas Improvement, Union Traction, and Philadelphia Rapid Transit only receded from ⅛ to ¾, where as the arbitrage issues, such as United States Steel and Reading, were down a point or more.

The Chicago City Railway Company has sold $500,000 first mortgage 5s to the Merchants' Loan & Trust Company, White, Weld & Company participating.

New Orleans bankers are offering at ninety-six and interest the unsold portion of the recent issue of $10,000,000, eight-year collateral trust five-six per cent bonds of the American Cities Company.

The New York Stock Exchange has admitted to the list $10,000,000 additional American Telephone & Telegraph Company collateral trust four per cent coupon bonds due 1929.

The Puebla (Mex.) Tramway, Light & Power Company proposes to issue $3,000,000 five per cent prior lien bonds, with the right to increase the amount to $6,000,000 in order to provide funds for the development of the Tuxpango Falls.

DIVIDENDS.

Boston Elevated Railway Company; regular semi-annual dividend of three per cent, payable August 15 to stock of record August 4.

Detroit United Railway Company; regular quarterly dividend of one and one-fourth per cent, payable September 1 to stock of record August 16.

Federal Light, Traction Company; an initial quarterly dividend of one and one-half per cent on the preferred stock, payable September 1 to stock of record August 15.

Mobile Electric Company; quarterly dividend of one and three-quarters per cent upon the preferred stock of the company, payable August 15.

Portland (Ore.) Railway, Light & Power Company; quarterly dividend of one per cent, payable September 1.

Minneapolis General Electric Company; common quarterly dividend of $1.75 per share, and semiannual preferred of $3, both payable August 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Aug. 7.	July 31.
Allis-Chalmers common	8	8
Allis-Chalmers preferred	28¼	28¼
Amalgamated Copper	63½	66⅞
American Tel. & Cable	78⅝	*78
American Tel. & Tel.	135¼	136⅜
Brooklyn Rapid Transit	77¾	81
General Electric	154½	162¼
Interborough-Metropolitan common	16⅝	17¾
Interborough-Metropolitan preferred	45	50
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	86	86
Mackay Companies (Postal Telegraph and Cables) preferred	74	74
Manhattan Elevated	74	136
Metropolitan Street Railway	18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47	47
U. S. Steel common	47⅜	79¼
U. S. Steel preferred	117	119¾
Western Union	76	79¾
Westinghouse common	67	73¾
Westinghouse preferred	118¼	118¼

*Last price quoted.

BOSTON.

	Aug. 7.	July 31.
American Tel. and Tel.	135¼	136⅜
Edison Electric Elluminating	287	285½
General Electric	155½	162¼
Massachusetts Electric common	21½	22¼
Massachusetts Electric preferred	147½	147
New England Telephone	149	92½
Western Tel. & Tel. common	20	20
Western Tel. & Tel. preferred	99	99

PHILADELPHIA.

	Aug. 7.	July 31.
American Railways	44½	44¼
Electric Company of America	12	12
Electric Storage Battery common	53⅛	55
Electric Storage Battery preferred	55	55
Philadelphia Electric	17⅝	17¾
Philadelphia Rapid Transit	23½	22¼
Philadelphia Traction	86½	86½
Union Traction	38½	51⅜

CHICAGO.

	Aug. 7.	July 31.
Chicago Elevated common	27	27
Chicago Elevated preferred	90	92½
Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	31½	28
Chicago Subway	3¼	3½
Chicago Telephone	123	122½
Commonwealth Edison	135	135
National Carbon common	111	111
National Carbon preferred	117	117

PERSONAL MENTION.

W. W. VOORHEES has resigned his position as manager of the Eureka, Ill., Farmers' Telephone Company to accept a place with the Kellogg Switchboard & Supply Company.

JOHN J. DECK has been elected vice-president of Dossert & Company, of New York, to fill the vacancy left by the resignation of Charles A. Flynn. D. J. Fitch has been elected secretary and treasurer of the company.

CHARLES A. OSBORN, JR., district traffic chief for the Central Union Telegraph Company at South Bend, Ind., has been transferred to the Iowa Telephone Company as district traffic chief in charge of the Dubuque, Iowa, district.

F. C. SARGENT, who was formerly electrical engineer for the Tenny Syndicate, has become engineering manager for the company's gas and electric properties in New England. His headquarters are at 201 Devonshire Street, Boston, Mass.

W. K. FREUDENBERGER has been appointed expert engineer for the Public Service Commission of Nevada, with headquarters at Carson City. Mr. Freudenberger was formerly electrical engineer for the Steptoe Valley Smelting & Mining Company of McGill, Nev.

CHARLES A. HENDERSON, secretary and treasurer of the Los Angeles Railway Company, Los Angeles, Cal., has been appointed assistant general manager in addition to his present title. He will take over the duties of Howard Huntington, general manager.

ARTHUR R. HILL has resigned as purchasing agent to the New York & Queens Electric Light & Power Company, of Long Island City, N. Y., and has been appointed to the position of purchasing agent to the Monterey Railway, Light & Power Company, of Monterey, Mex., (which also includes the Monterey Water Works & Drainage Company and the Monterey Plumbing & Electrical Supply Company, also, now under construction, the Monterey Gas Company).

C. S. DAVIDSON has resigned as manager of the street-lighting department of the Holophane Company, Newark, Ohio. Mr. Davidson has been connected with the Holophane Company for the past three years and before that was in the central-station business at Montpelier, Vt. He has bought a part interest in the manufacturers' agency held by W. G. A. Reid, of Detroit, Mich. The company will cover the state of Michigan with agencies which Mr. Reid now represents, and a number of new lines will be added in the near future.

EDWIN M. HERR, who was elected president of the Westinghouse Electric & Manufacturing Company at a meeting of the Board of Directors held in New York August 1, has been the first vice-president of this company and in charge of operation at East Pittsburg since June 1, 1905. Mr. Herr was born in Lancaster, Pa., May 3, 1860. Upon completion of a common school course, he was given the position of telegraph operator on the Kansas Pacific Railroad, with which company he remained for two years. He was promoted from the construction train service to the position of station agent. In 1881 he entered the Sheffield Scientific School of Yale, graduating in the Class of 1884, and worked as an apprentice in the shops of the Pennsylvania Railroad Company at Altoona, Pa., during the two summer vacations. From 1884 to 1885 he was an apprentice at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railroad. He then went to the Chicago, Burlington & Quincy Railroad Company as a draughtsman in the mechanical engineer's office, and afterwards became assistant engineer of tests, and was promoted from this position to engineer of tests on this road at Aurora, Ill. From 1887 to 1889 he was superintendent of telegraph, and from 1889 to 1890 was division superintendent of this road. From 1890 to 1892 he was division master mechanic of the Chicago, Milwaukee & Saint Paul Railroad at West Milwaukee. From 1892 to 1894 he was superintendent of the Grant Locomotive Works at Chicago. From 1895 to 1897 he was superintendent of motive power and machinery of the Chicago & Northwestern Railroad. From June 1, 1897, to September 10, 1898, he held the same position with the Northern Pacific Railroad. On September 10, 1898, he became assistant general manager of the Westinghouse Air Brake Company, at Wilmerding, Pa. He was promoted to the position of general manager on November 1, 1899, which position he held until June 1, 1905, when he was elected first-vice-president of the Westinghouse Electric & Manufacturing Company.

EDWIN M. HERR.

W. H. WHITESIDE was elected a director of the Stevens-Duryea Company at a meeting of the stockholders at Chicopee Falls, Mass., on July 29. A meeting of the board of directors later elected Mr. Whiteside president of the company to fill the vacancy caused

by the resignation of Irving H. Page. Mr. Page was elected chairman of the board of directors and treasurer of the company. Outside of an interest which Mr. Whiteside will have in the company, there is no other change in the ownership and control of the securities of the company. A further official statement was made that the company does not contemplate the purchase of nor the consolidation with any other automobile interests. Mr. Whiteside, who recently resigned the presidency of the Allis-Chalmers Company, is an experienced manufacturer and organizer, and brings to the company a knowledge that promises a progressive policy for the Stevens-Duryea Company.

LE MOYNE L. PARKINSON, of Pittsburg, Pa., has resigned his position with the Standard Underground Cable Company of that city to become district sales manager of the Esterline Company of Lafayette, Ind. Mr. Parkinson will have charge of the State of Michigan, having his office at Detroit. Mr. Parkinson was graduated from Geneva College in 1895, and the same year entered the employ of the Beaver Valley Water Company, in whose employ he continued for eleven years, as assistant general manager. He is also a graduate of Rand's Commercial College, and of a special course in electrical engineering at the Cosmopolitan University, New York City. Mr. Parkinson entered the employ of the Standard Underground Cable Company in the sales department in 1906, taking charge of the sales of standard underground cable for electrical purposes. He has a wide acquaintance in the electrical field and his experience in the work promises success for him and his company.

LE MOYNE L. PARKINSON.

LEGAL NOTES.

TO PROTECT WIRES.—An ordinance has been passed by the City Council of Richmond, Ind., preventing the disturbing of telephone, telegraph or power lines by house-movers. It provides that no moving shall be done where such work would require the temporary removal or readjustment of lines with the consequent disturbance or possibility of disturbance of the service of a subscriber connected to that or other lines of the system. S.

LAWFULLY ERECTED POLES ALONG HIGHWAYS NOT NUISANCES.—The Court of Appeals of Kentucky says that, although it may be stated as a general principle that the public is entitled to the unobstructed use of every part of a public road, yet, when a telephone company is given the right to erect its poles along the highway, it necessarily follows that it must erect them in that part of the highway set apart for the use of the public, and so the grant carries with it the authority to partially obstruct the road. It is a matter of common knowledge that with few exceptions all the public roads in the state that run through cultivated farm lands are fenced on each side and that on nearly all of these roads there are telephone poles set along the edge of the road between the fence and the traveled part of the road. But it has never been ruled that a pole erected lawfully on ground laid out as a public road is a nuisance, unless it was erected in the traveled part of the road, or so close as to interfere with or obstruct the use of the road by the traveling public. The liability of the company for placing an obstruction or obstacle in the road would be the same in an action to recover damages for injuries caused by it if horses were running away as it would be if they were under control, assuming that the driver was exercising ordinary care for his own safety.—Jackson-Hazard Telephone Company vs. Holliday's Administrator, 136 S. W. 135.

VALIDITY OF RULES AND REGULATIONS.—A company authorized under a franchise to carry on a business public in its nature, such as furnishing electricity to the inhabitants of a city, may adopt and enforce whatever rules and regulations, or pursue any course of conduct it may deem necessary to protect its interests, providing they are reasonable, and a rule that the particular service may be discontinued as to nay patron who fails or refuses to pay the price of the service when due is reasonable. But, the Supreme Court of Montana holds, a corporation engaged in supplying the inhabitants of a city with electricity, with the powers and privileges conferred by its charter and a franchise under which it is conducting its business, may not impose restrictions designed to extend tne same protection to other business conducted by it having no connection with the franchise granted by the city for a specific purpose. For example, it will ot be justified in making a rule that it will not serve electricity to any one who steals its gas, and that it will not sell gas to any one who steals its electricity until all reasonable bills and charges for both gas and electricity are paid, it not being alleged that it possesses a franchise to supply gas to the inhabitants of the city.—State ex rel. Deeney vs. Butte Electric & Power Company, 115 Pac. 44.

INDUSTRIAL ITEMS.

THE SAFETY-ARMORITE CONDUIT COMPANY, Pittsburg, Pa., has prepared a folder quoting the latest prices of "Sterling" flexible steel conduit and armored conductor.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, Ill., has published a night photograph of Michigan Boulevard in the last issue of its publication, *The Federalist*. Mention is made of the fact that Federal weatherproof sockets are used in the installation.

MACBETH-EVANS GLASS COMPANY, Pittsburg, Pa., is distributing a handsome booklet illustrating and describing Alba pendent spheres. An interesting feature of this publication is the reproduction on a number of illustrations of installations in prominent buildings, stores, etc.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., has issued bulletin No. 481 devoted to alternating-current generators of the direct-connected type. This bulletin illustrates and describes, in detail, the company's line of alternating-current machines suitable for direct connection to engines and water wheels.

THE JAEGER MINIATURE LAMP MANUFACTURING COMPANY, of New York, has opened a branch office at the Rand-McNally Building, 157-173 West Adams Street, Chicago. A full line of the Jaeger miniature lamps, automobile lamps, novelty outfits and Christmas tree outfits will be carried in stock at the Chicago wareroom, which is located in close proximity to the office.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just issued a very attractive publication devoted to a detailed description of its double-truck type of gas-electric car. The publication is elaborately illustrated, and contains considerable data relative to the subject. It includes plans and elevations of cars of various sizes. Any one interested may secure this information by writing for Bulletin No. 4855.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg Pa., has revised editions of the following sections of Perpetual Catalogue No. 3001; No. 121 on "Type CC Carbon Circuit-Breakers; No. 231 on "Expulsion-Type Fuse Blocks"; No. 233 on "Outdoor-Type Fuse Blocks;" No. 327 "Type C Watt-Hour Meters," and No. 667 on "Type D Generator and Feeder Panels." These revised sections embody new features of interest.

THE D. & W. FUSE COMPANY, Providence, R. I., is distributing a new catalog devoted to non-arcing fuses and safety devices for lighting, railway, power, signal, heating, telephone and telegraph circuits. The catalog is very complete and in addition to listing the standard material manufactured by the company, presents data relative to the construction, design and installation of the materials listed.

THE CHICAGO RAWHIDE MANUFACTURING COMPANY, Chicago, Ill., gives an account, in a recent catalogue, of the growth and development of the idea of the rawhide gear. This gear was invented by the late Capt. I. R. McCutcheon in 1881, but the use of it did not grow to any extent until the use of direct drive with electric motors became common. The process of making the gears is described, and a number of rules applying to the use of them are given.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., announces that it has received the following order from the Sanitary District of Chicago: Sixteen 250-kilovolt-ampere 12,000-volt, sixty-cycle Pittsburg transformers to be used in the new city lighting scheme, power being secured from the Chicago drainage canal. This contract was secured by the Republic Electric Company, Chicago, Ill., whose business has been recently consolidated with that of the Delta-Star Electric Coompany, western agents of the Pittsburgh Transformer Company.

THE FEDERAL MINIATURE LAMP COMPANY, 812 Hippodrome Building, Cleveland, Ohio, has established a branch office at 301 Fort Dearborn Building, Chicago, Ill. The new office is in charge of Frederick S. Armstrong, who has had about fifteen years' experience in the lamp business; he is a brother of Walter R. Armstrong, general manager of the company. The Chicago warerooms are located in the Cambridge Building, corner of Randolph Street and Fifth Avenue. More than 100,000 miniature lamps, embracing scores of different styles and types, are here carried in stock.

W. N. MATTHEWS & BROTHER, 203 North Second Street, St. Louis, Mo., are distributing some very interesting literature describing their guy anchors and the Matthews two-bolt guy clamp. The Matthews guy anchor does way with digging and in many places where property owners would object because of the mutilation of their shrubbery and grounds by the ordinary anchor, the Matthews guy anchor can be installed and prove a ready favorite. The two-bolt guy clamp, it is stated, costs thirty-two cents less to install than it does to put on any kind of a three-bolt clamp. Tests made by the engineering department of the Union Electric Light & Power Company, of St. Louis, showed that on Matthews two-bolt clamp would hold more than two three-bolt clamps and that the strand would break before the clamp could slip. As a result of these tests the Union Company has adopted these clamps exclusively and has over 5,000 in use. Copies of these tests and full information will be sent upon request.

DATES AHEAD.

National Electrical Supply Jobbers' Association. Saratoga Springs, N. Y., August 16, 17, 18. Headquarters, United States Hotel.

Indiana Electric Light Association. Annual convention, South Bend, Ind., August 23 and 24.

Institute of Operating Engineers. First annual convention, New York City, September 1-3.

Old Time Telegraphers' and Historical Association and the United States Military Telegraph Corps. Thirtieth annual reunion, Atlantic City, N. J., September 5-7.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

Vermont Electrical Association. Annual meeting, Lake Dunmore, Vt., September 13 and 14.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

Northwest Electric Light and Power Association. Annual convention, Spokane, Wash., September 21 and 22.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21-23.

Illuminating Engineering Society. Annual convention, Chicago, Ill., September 25-27.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association and affiliated associations. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

Directory of Electrical and Allied Engineering and Scientific Societies

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NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 Thirty-ninth Street, New York, N. Y.
NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.
NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.
NORTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary and treasurer, L. C. Kane, Kensal, N. D.
NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.
OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.
OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, O.
OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. E. Sanborn, Ohio State University, Columbus, O.
OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.
OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Sherrer, 195 Broadway, New York, N. Y.
ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, Roy M. Van Vliet, Monadnock Block, Chicago, Ill.
PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION, Secretary, A. H. Halloran, 901 Atlas Building, San Francisco, Cal.
PENNSYLVANIA ELECTRICAL ASSOCIATION. Secretary, Van Dusen Rickert, Pottsville, Pa.
PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.
PHILADELPHIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. G. Sellers, Philadelphia, Pa.
PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo.
PITTSBURG ELECTRIC BOOSTERS' CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Avenue, Pittsburg, Pa.
RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. Secretary, J. Scribner, General Electric Company, Chicago, Ill.
RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.
SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.
SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS. Secretary, David H. Bates, 658 Broadway, New York, N. Y.
SOCIETY OF AUTOMOBILE ENGINEERS. Secretary, Alexander Churchward, 30 Church Street, New York, N. Y.
SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin Street, South Framingham, Mass.
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SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, D. G. Fisher, Dallas, Tex.
STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.
TELEPHONE SOCIETY OF NEW YORK. Secretary, T. H. Lawrence, Eighteenth Street and Irving Place, New York, N. Y.
TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Leon Spencer, Gainesville, Tex.
UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk Street, Boston, Mass.
UTAH SOCIETY OF ENGINEERS. Secretary, W. C. Ebaugh, University of Utah, Salt Lake City, Utah.
VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsburg, Vt.
VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.
WASHINGTON SOCIETY OF ENGINEERS. John C. Hoyt, 1330 F Street, Washington, D. C.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Secretary, J. H. Warder, Monadnock Block, Chicago, Ill.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, Room 1909, 42 Broadway, New York, N. Y.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Milwaukee Electric Railway & Light Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

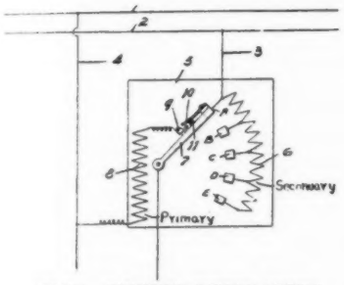
WISCONSIN STATE TELEPHONE ASSOCIATION. Secretary, Paul J. Weirich, Monroe, Wis.

RECORD OF ELECTRICAL PATENTS.

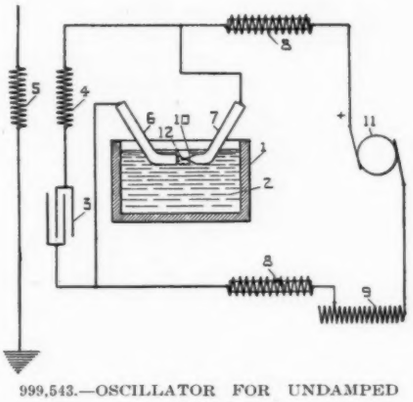
Issued (United States Patent Office) August 1, 1911.

999,196. APPLIANCE FOR PREVENTING FRAUD IN CONNECTION WITH ELECTRICITY-METERS. Giacomo Berardi, Genoa, Italy. Filed Aug. 21, 1909. An attempt to tamper with the meter by means of a magnet causes two contacts to come together in a short circuit, which opens the main switch.

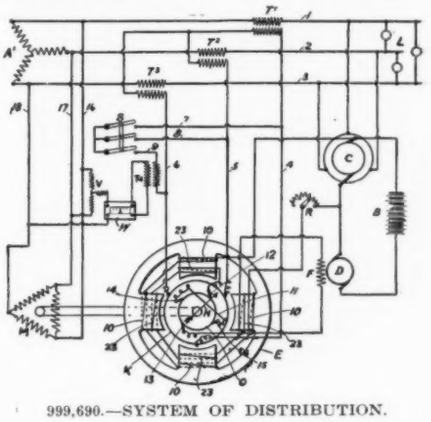
999,216. PHOTOGRAPHIC-PRINTING APPARATUS. William F. Folmer, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y. Filed Apr. 10, 1909. A mercury-vapor lamp is mounted in a tiltable casing, which normally holds the lamp in a vertical position, but which allows the lamp to be turned to horizontal starting and inclined operating positions when needed.



999,245.—FEEDER-REGULATING TRANSFORMER.



999,543.—OSCILLATOR FOR UNDAMPED WAVES.



999,690.—SYSTEM OF DISTRIBUTION.

999,234. ELECTRIC LAMP SOCKET. Frederick A. Lavercombe, Newport, Ky. Filed July 23, 1909. A keyed socket contains a porcelain plug core.

999,235. PROCESS FOR THE PRODUCTION OF TUNGSTEN FILAMENTS. Anton Lederer, Atzgersdorf, near Vienna, Austria-Hungary, assignor to Westinghouse Lamp Co., Bloomfield, N. J. Filed June 10, 1908. Renewed Jan. 17, 1911. This process for obtaining a plastic mass suitable for squirting filaments of pure tungsten, consists in reducing an oxide of tungsten by means of zinc at a red heat, treating the product with acid, washing and subsequently concentrating to the required consistency.

999,241. HEATING AND DRYING MACHINE. Frank P. Mies, Chicago, Ill. Filed May 16, 1910. Comprises a rectangular main casing, provided with an air opening on one side, an electric motor within this casing, a circular fan casing within the main casing provided with a tangential extension opening, a fan connected to the motor, and a heating device secured to the rear peripheral wall in the fan casing to heat the air passing through.

999,245. FEEDER-REGULATING TRANSFORMER. George Spencer Neeley, St. Louis, Mo. Filed Aug. 27, 1909. An autotransformer has its secondary winding brought out to a number of contacts on the arc of a circle. A movable contact arm is arranged so that it opens the primary circuit at the same time that all the sections of the secondary have been cut out.

999,298. ELECTRIC SAFETY LAMP. Bruno Christiansen, Cologne-Sulz, Germany. Filed Apr. 4, 1911. Contains a storage battery above which is a crosshead with a lamp at the top. Turning the cross head either way closes the lamp circuit.

999,312. TROLLEY-SWITCH FOR STATION-INDICATORS AND THE LIKE. Orlando E. Kellum, Los Angeles, Cal., assignor to National Street & Station Indicator Co., Los Angeles, Cal. Filed Nov. 23, 1910. On each side of the trolley ear is a downwardly and outwardly extending arm with an inward upturned extension at the bottom forming a contact point. The trolley pole carries a contact device below the trolley wheel which is adapted to ride over the pair of contacts and thus close the indicator circuit.

999,335. MAGNETO-GENERATOR. William D Pennington and John Rawson Pennington, Chicago. Ill., assignors to Draper-Latham Magneto Co., New York, N. Y. Filed Jan. 20, 1910. Comprises an annular series of generating coils and a rotary member carrying a series of permanent magnets having their ends bent to point inwardly toward the coils and their end faces arranged in proximity to the coil ends.

999,340. ARC-LAMP. Oscar A. Ross, Chicago, Ill., assignor to Albert H. Meads, Chicago, Ill. Filed May 29, 1902. The upper electrode feeds between wto parallel rods. An electromagnet operates a clutch that has projections fitting into elongated slots in the rods.

999,343. SPARK-PLUG. Albert Schmidt, Flint, Mich., assignor to Champion Ignition Co., Flint, Mich. Filed July 26, 1909. Relates to details of construction.

999,367. CALL SYSTEM FOR TELEPHONE CIRCUITS. Joseph J. Garf, Scranton, Pa. Filed May 26, 1910. A selective signaling system for party lines.

999,414. HIGH-TENSION STRAIN INSULATOR. Louis Steinberger, New York, N. Y. Filed Feb. 18, 1910. The body of the insulator has two V-shaped longitudinal slots whose planes are at right angles and which contain steel tension hooks that interlace and have a hook at the outer ends of their legs.

999,421. ELECTRIC IRON. Albert Wicks, Guelph, Ontario, Canada, assignor, of one-half to Norman A. Wicks and one-half to Harry J. Compton, Woodstock, Ill. Filed Mar. 16, 1911. The base of the iron has a cavity into which the heating element fits. On top of this is a heat-retaining core.

999,441. RADIATOR-SECTION. Frederick A. Feldkamp, Union. N. J., assignor to Electrolytic Products Co. Filed Oct. 28, 1909. a hollow one-piece honeycomb automobile radiator-section provided with a multiplicity of minute air passages, the walls of which are of uniform thickness throughout, which thickness is produced by electrolytically depositing metal upon a core or pattern, first by directing the depositing current from an exterior anode to produce a deposition within a multiplicity of holes in the core, and secondly, by directing the depositing current from the anode to produce a deposition upon the whole surface of the core and upon the electrolytic deposition of metal within the holes.

999,444. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS. Thomas M. Freeble, Rochester, Pa., assignor to Freeble Automatic Stop & Cab Signal Co., Pittsburg, Pa. Filed June 21, 1909. A block signal system with an auxiliary sectional conductor on which bears a contact arm attached to the locomotive. In the latter are lamp signals and electromagnetic means for closing the throttle and applying the brakes.

999,505. COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM. Oscar M. Leich, Genoa, Ill., assignor to Cracraft-Leich Electric Co., Genoa, Ill. Filed June 19, 1908. Includes both telephone and telegraphic instruments in series on the same single grounded line and adapted for simultaneous use.

999,520. SAFETY DEVICE FOR REVERSIBLE WINDING OR

HAULING PLANTS. William Philip, Germinston, Transvaal. Filed Aug. 30, 1909. An electric signal-controlling device is actuated when the skip reaches a predetermined point near the end of its travel.

999,521. BINDING-BLOCK FOR TERMINAL WIRES. Clarence D. Platt, Bridgeport, Conn. Filed May 7, 1910. Combined with a cap having a perforation for the passage of electric wires, is a free block of insulating material arranged to clamp the separate wires to the cap.

999,534. MULTIPLE-UNIT COIL. Ernest C. Wilcox, Meriden, Conn., assignor to Connecticut Telephone & Electric Co., Meriden, Conn. Filed Jan. 10, 1910. Includes a number of induction coils in the same casing. The primaries have a common connection and are in circuit with either one of a duplicate set of vibrators.

999,541. ELECTRICALLY HEATED FLATIRON. Raymond W. Baker, New York, N. Y., Victor L. King, Woodridge, N. J., and Herschel C. Parker, New York, N. Y., assignors to Parker-Clark Electric Co., New York, N. Y. Filed Dec. 29, 1909. A hollow flatiron having an insulating block therein, the surface of which next the face of the iron being chambered, a thin non-conducting strip between the chamber and the face of the iron, an open-air-glowing filament supported in the chamber and near the non-conducting strip, and electrical connections for the filament.

999,543. APPARATUS FOR PRODUCING UNDAMPED ELECTRICAL OSCILLATIONS. Edgar S. Beck, Treichlers, Pa. Filed Jan. 28, 1910. Consists of a container holding a liquid, a negative electrode having a blunt terminal and a positive electrode having a pointed terminal slightly submerged in the liquid and disposed opposite the negative, a source of continuous current connected with the electrodes, and an alternating circuit including the electrodes and also inductance and capacity.

999,565. VIBRATOR FOR INDUCTION-COILS. Edward B. Jacobson, Pittsfield, Mass., assignor to Jacobson-Brandow Co., Pittsfield, Mass. Filed Aug. 31, 1910. Relates to a method of adjustment of the vibrating element.

999,568. ELECTROLYTE AND METHOD OF DEPOSITING ZINC. Edward Frank Kern, Knoxville, Tenn., assignor of one-half to Percy S. Brown, New York, N. Y. Filed Dec. 18, 1909. Consists in electrolyzing a solution containing chloride of inc, chloride of aluminum, chloride of sodium and grape sugar.

999,578. ELECTRIC-CONTROLLER. Louis A. de Mayo, New York, N. Y. Filed Mar. 20, 1909. A form of overload release which releases the arm of the motor-starting box when excess current flows through the release magnet coil.

999,581. PRESSING IRONS. Frederick A. Mills, New York, N. Y. Filed Aug. 18, 1908. A pair of box-like irons, one of which contains on electric heating element, is adapted to be pivoted face to face, a spring pressing them together.

999,586. ELECTRIC FURNACE. Harry Pauling, Gelsenkirchen, Germany, assignor to Salpetersaure Industrie-Gesellschaft, Gelsenkirchen, Germany. Filed Mar. 17, 1909. Comprises an electrode chamber, a pair of electrodes suitably positioned therein, and a number of alternately disposed air inlets and gas outlets between the electrodes.

999,587. ELECTRIC FURNACE FOR TREATING GASES. Harry Pauling, Gelsenkirchen, Germany. Filed Mar. 27, 1911. A furnace wall having its surface next the electric flame subdivided into a number of separate elements by a network of connected passages extending to a depth in said wall at which the latter does not become heated sufficiently to be electrically conductive.

999,618. ELECTRIC COOKER. Lee Yancey and Jacob W. Luppold, Denver, Colo. Filed Feb. 21, 1911. Consists of an oven with heat-insulating walls and an electric heating element at the base of the oven.

999,624. TROLLEY. Richard Black, Cannonsburg, Pa. Filed July 26, 1910. An oblique trolley pole has a horizontal arm with an elbow and shank at its lower end fitting into a vertical tubular socket in the car to permit of reversal.

999,655. ELECTROLYTE FOR DEPOSITING ZINC. Edward F. Kern, New York, N. Y., assignor of one-half to Percy S. Brown, New York, N. Y. Filed Oct. 11, 1910. Comprises chloride of zinc and a double chloride of aluminum and sodium.

999,683. INSULATOR. Addison B. Tinsley, Anstead, W. Va. Filed Mar. 1, 1910. Two porcelain insulating blocks with wire grooves between them are clamped between two standards.

999,690. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph Lester Woodbridge, Philadelphia, Pa. Filed June 19, 1909. Associated with a storage battery for floating on an alternating-current system is a rotary converter and a booster. For the field of the latter a special motor-driven regulator is provided.

999,694. AUTOMATIC MACHINE FOR STRIPPING AND RECOVERING WIRE. James H. E. Branson, Philadelphia, Pa. Filed Feb. 25, 1911. Comprising a series of staggered bolts extending from a plate, the bolts having threads engaging the insulation to rip the same from the wire, combined with means to scrape or clean the wire and means to apply a fillet, strip or tape to the wire.

999,710. CONSTANT-TEMPERATURE BATH. Thomas B. Freas, Chicago, Ill., assignor to V. Weber & Co., Chicago, Ill. Filed Sept. 1, 1909. Includes an electric heater, electromagnetic means for operating its switch, thermoresponsive means subject to the temperature of the bath for controlling the circuit through the electromagnet, an auxiliary heater, and thermoresponsive means subject to the temperature of the surrounding air for controlling it.

999,719. ELECTRIC-FURNACE ELECTRODE. Carl Hering, Philadelphia, Pa. Original application filed July 6, 1909. Divided and this application filed Feb. 17, 1911. An electrode having such length and cross section that the furnace current flowing through it raises the electrode at its furnace end by its own resistance to a temperature equal to furnace temperature.

999,720. ELECTRIC FURNACE. Carl Hering, Philadelphia, Pa. Original application filed Feb. 17, 1911. Divided and this application filed May 2, 1911. Is provided with a resistor, a number of electrodes electrically communicating with it, and an insulating dividing wall between the electrodes, the latter being proportioned for minimum electrode loss whereby the distance between the electrodes is small and the area inclosed by the furnace circuit is small and the power-factor great when alternating current is passed through.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office), that expired August 1, 1911:

523,897. ELECTRIC-WELDING MACHINE. Hermann Lemp, Lynn, Mass.

523,986. PROCESS OF ELECTRIC METAL WORKING. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass.

523,995. ELECTRICAL MOTOR. Henry B. Porter, New York, N. Y.

523,998. DYNAMO-ELECTRIC MACHINE. Gustafrennerfelt, Lynn, Mass.

524,003. ELECTRIC-ARC LAMP. George G. Stout, Parkersburg, W. Va.

524,009. TELEPHONE ANNUNCIATOR AND CALL-BELL. Frederick G. Warrell, Philadelphia, Pa.

524,011. ELECTRIC MOTOR. Frederick C. Whitmore, Lynn, Mass.

524,017. TROLLEY FOR ELECTRIC CARS. George C. Bourdereaux, Peoria, Ill.

524,020. DYNAMO-ELECTRIC MACHINE. Rudolf Eickemeyer, Yonkers, N. Y.

524,025. CONDUIT ELECTRIC RAILWAY. Rudolph M. Hunter, Philadelphia, Pa.

524,038. RAILWAY SIGNALING DEVICE. William Daves, Jersey City, N. J.

524,044. ELECTRIC PUMP. Frank W. Merritt and Arthur R. Roe, Duluth, Minn.

524,062. ELECTRIC HEATER. Jesse P. Kester, La Grange, Ill.

524,066. WATERPROOF INSULATED ELECTRIC CONDUCTOR. Duncan MacFarlin, Philadelphia, Pa.

524,075. REFLECTOR FOR ELECTRIC OR OTHER LAMPS. Ernest Tilmann, New York, N. Y.

524,076. REFLECTOR FOR LAMPS. Ernest Tilmann, New York, N. Y.

524,100. SUPPORTING-INSULATOR FOR ELECTRIC WIRES. Lauren S. Beardsley, Naugatuck, Conn.

524,109. ROSETTE FOR ELECTRIC-LIGHT WIRES. Charles Hammond, Boston, Mass.

524,116. ELECTRIC-ARC LAMP. William S. Pendleton, New York, N. Y.

524,119. DYNAMO-ELECTRIC MACHINE. William B. Sayers, Glasgow, Scotland.

524,120. ELECTRIC HAND APPLIANCE FOR MASSAGE. Andrew J. Speare, Thayer, Mo.

524,136. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Thomas A. Edison, Menlo Park, N. J.

524,156. THERMO-ELECTRIC VOLATIZING OBTUNDER. Otto B. Bachman, Minneapolis, Minn.

524,165. CIRCUIT-BREAKER FOR ELECTROTHERAPEUTIC APPARATUS. Louis W. Downes, Providence, R. I.

524,168. GUARD FOR GLOBES OF ELECTRIC LIGHTS OR LAMPS. John C. Galster, Philadelphia, Pa.

524,172. VARIABLE-RESISTANCE MEDIUM FOR TELEPHONES. William W. Jacques, Newton, Mass.

524,173. VARIABLE RESISTANCE MEDIUM FOR TELEPHONES. William W. Jacques, Newton, Mass.

524,188. ELECTRIC TRANSFORMER. James J. Wood, Fort Wayne, Ind.

524,202. ELECTRIC SIGNAL FOR STEAMBOATS. Robert H. Gruschow, Chicago, Ill.

524,250. ELECTRIC SASH-BALANCE. William C. Hodgkins, Washington, D. C.

524,282. ELECTRIC-RAILWAY POLE-RATCHET. Thomas J. McTighe, New York, N. Y.